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Current Science

Vol. 30, No. 9 SEPTEMBER 1961 Pages 323–362

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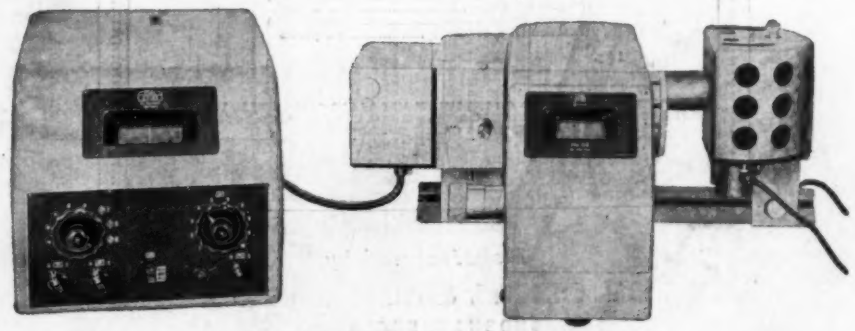

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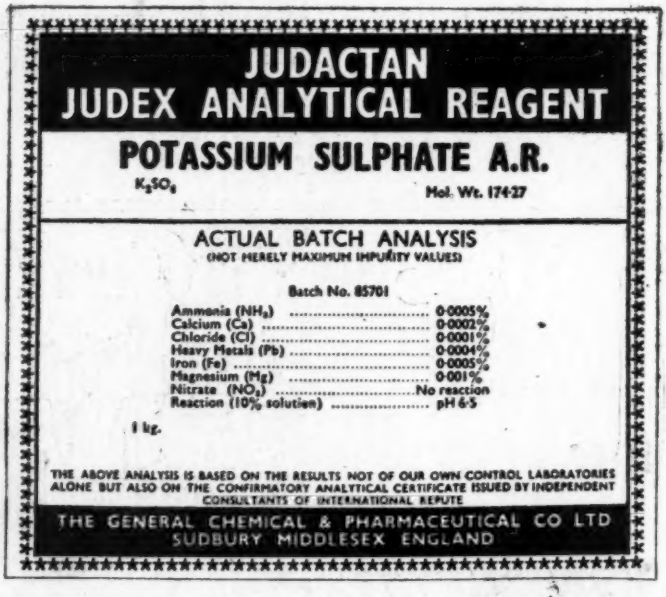

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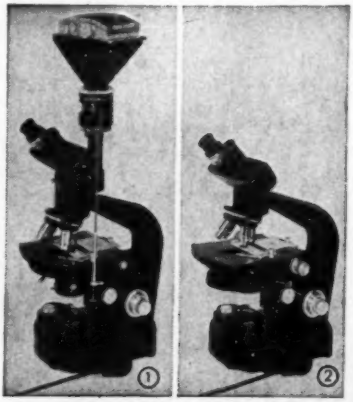

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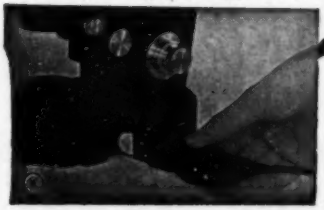

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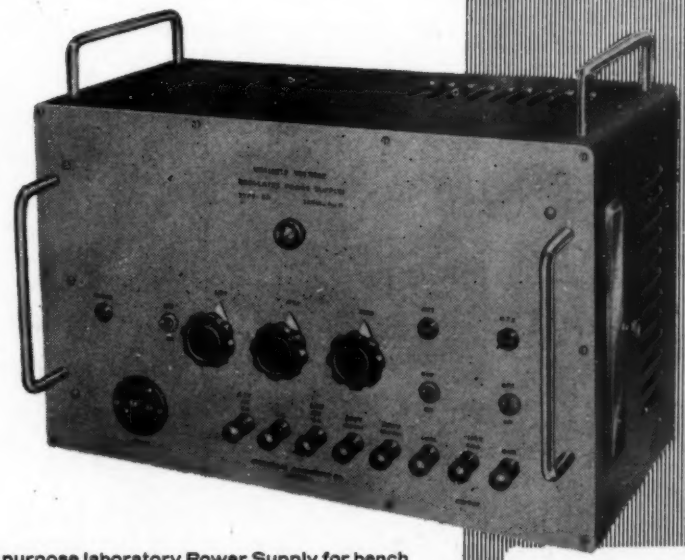

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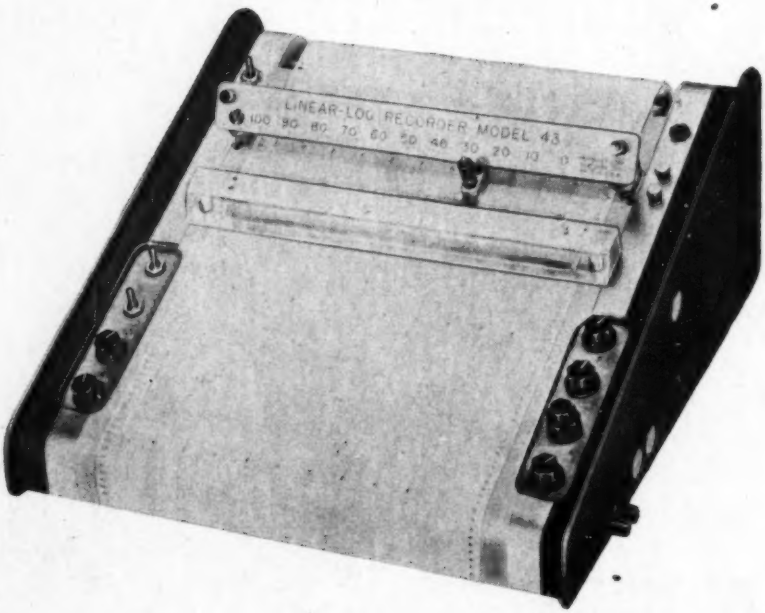

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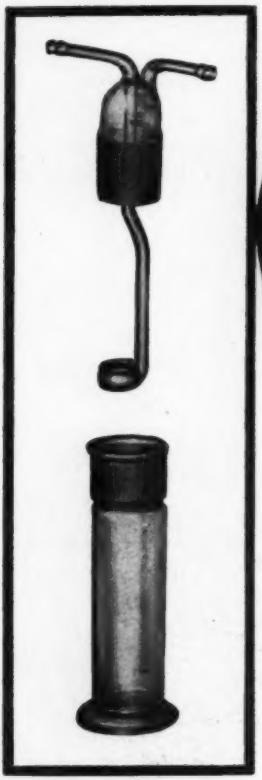

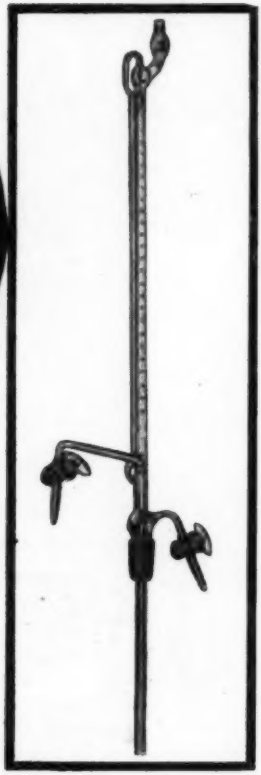

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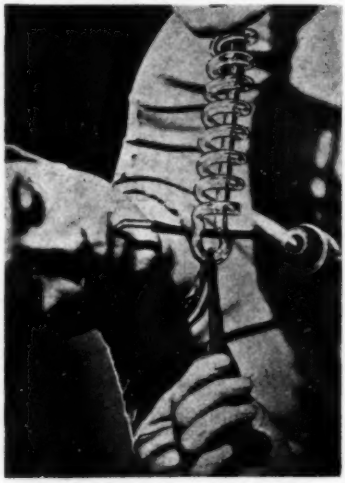

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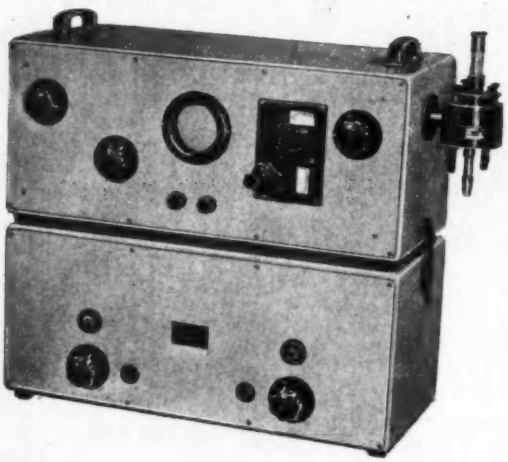

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EXTRACTING ELECTRICITY FROM FLAMES

IAN FELLS
Department of Fuel Technology and Chemical Engineering
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MAN has known about and pondered on the nature of fire almost since the beginning of civilization. Some of the first scientific experiments carried out on flames were reported by Gilbert, physician to Queen Elizabeth I, in his book *De Magnete*, published in London in 1600. He showed that flames were electrically charged. It is precisely this electrical property of flames that is the basis of the new method of electric power generation called, rather forbiddingly, magnetohydrodynamics (M.H.D.).

Conventional methods for producing electricity are notoriously inefficient, not because the plant (which usually incorporates some sort of hot fluid impinging on turbine blades causing them to rotate an armature in a magnetic field) is badly designed, but because the second law of thermodynamics restricts the efficiency to something like 40% of the available energy in the fuel. No amount of plant improvement can increase this efficiency unless a completely different generating principle is used.

Various methods for generating electricity more efficiently have been investigated from time to time. Grove, in 1800, was experimenting with fuel cells, and Faraday, in 1832, carried out the first experiment on power generation using a moving fluid conductor (M.H.D.).

In this experiment Faraday pumped a stream of mercury (the fluid conductor) through a magnetic field and was able to generate a current in an external circuit by placing in the mercury stream a pair of electrodes set at right angles to both the mercury flow and the magnetic field.

It is interesting to note that the two most modern methods of electricity generation, by means of fuel cells and by magnetohydrodynamics, both have their origins in experiments carried out more than 100 years ago.

Modern methods of M.H.D. power generation have dispensed with mercury as the moving fluid conductor and use, instead, a partially-ionised stream of combustion products, a flame, in fact. The ionisation occurring in flames, first noticed by Gilbert, is increased by the addition of small quantities of potassium, a metal which ionises easily and provides a further source of charged particles.

The first M.H.D. generators have been constructed along relatively simple lines. The high-speed ionised gas stream is produced by what is, in effect, a rocket motor; fuel and oxygen are fed into a high intensity combustion chamber and the high temperature products of combustion, seeded with potassium to improve their conducting properties, are passed through a supersonic nozzle to increase their velocity (unfortunately this process causes a drop in temperature and hence in ionisation level) and then through a strong magnetic field. Current is taken out of the system by means of electrodes set at right angles to the gas stream and the magnetic field, as in Faraday's first experiments.

This type of generator suffers from several disadvantages: the cost of seeding the fuel with potassium is high, the temperatures in the system are very high (about 2,800° C.) and, although such temperatures can be used in a device without moving mechanical parts, serious material problems have to be solved, particularly if the generator is to have a long life. Another disadvantage of both the fuel cell and an M.H.D. generator in its simple form is that they produce low voltage direct current which must be converted to alternating current for general commercial use.

These problems are being solved in various ways. More sophisticated systems than the simple linear flow crossed field type are being developed, in which the driver gas stream is pulsed in various ways. This makes possible methods of current collection which do not necessitate putting electrodes in the high temperature gas stream itself; induction methods and parametric amplification are two other methods used.

The pulsed system also makes possible direct production of alternating current. The pulsed systems used are, in effect, streams of highly-ionised striations carried along by a high-velocity, non-conducting driver gas stream and they can be produced in various ways by suitable tailoring of the combustion system. Some of these principles can be used in closed cycles systems in nuclear piles which run at high temperatures and electricity can be generated more efficiently and, it must be said, more elegantly, than merely using the pile to raise steam for a conventional generator set.

The basic property of the gas stream, which is of importance in generator design, is the gas

conductivity, and a fundamental research programme is being carried out at the University of Sheffield and other institutions to examine the basic ion-producing mechanisms occurring in the flames, with the intention of encouraging them to produce more ions and thus do away with the need to add potassium. At the same time, more sophisticated methods of generator design are being developed.

The problems of electrical engineering and materials technology involved are considerable. Nevertheless, there is tremendous scope for ingenuity in devising better and more efficient M.H.D. generators, and if the inventiveness applied to the improvement of turbo-generators during the last 50 years can be channelled into producing new methods of electricity generation it seems not unreasonable to expect that a practical and efficient M.H.D. generator will be developed.

THE HUMANITY OF MAN

THE 123rd Annual Meeting of the British Association for the Advancement of Science was held at Norwich, England, from August 30 to September 6, 1961, with Sir Wilfrid Le Gros Clark, F.R.S., Professor of Anatomy at Oxford since 1934, as its President.

Two things are essential to a correct appreciation of science today: firstly, the knowledge that it is a continuing activity, and secondly, that it is a co-operative activity. A scientist learns from all those who have gone before him and adds his knowledge to what they have already produced; what he himself learns can only be fully used if it is known and shared by other scientists. Rightly, therefore, has Sir Wilfrid chosen as the title of his presidential address for this year's meeting "The Humanity of Man", to develop his thesis that the scientific attitude may be regarded as the culminating expression of the co-operative element in the human form of society.

Sir Wilfrid said: "Our task is to inculcate as widely as possible the spirit of freedom in scientific inquiry that gives full expression to deep-rooted altruism which is an essential attribute to the humanity of man, and which, I believe, can do more than anything else to preserve and intensify the feeling of harmony among all the peoples of the world. But we need to press ahead in our efforts with the utmost vigour, for the dangers which now threaten the unity of mankind are formidable indeed, and time is getting very short."

An essential prerequisite for any attempt at further unification for the good of mankind, said Sir Wilfrid, was the ability to give full expression to the impulse for co-operation which was so characteristic a feature of the humanity of man. That could only be made possible by opportunities for free intercourse and free interchange of ideas among the peoples of the world.

He believed that science had a vitally important part to play in the promotion of such an ideal. The progress of science was essentially a result of co-operative human effort. Secretiveness was the very antithesis of the spirit of free inquiry implicit in the scientific method.

Dealing with international co-operation in scientific research, Sir Wilfrid said that one of the most important developments in science during recent years was the multiplication of international congresses and similar meetings. This is an expression of the urgent need felt by the scientifically-minded to maintain and extend still further contacts in the world which threaten to become disrupted by the conflict of national interests.

Sir Wilfrid advocated replacing "national" research by "regional" research for the study of problems of common interest in different geographical areas. The immediate and obvious advantages which accrue from regional research in relatively undeveloped countries are more likely than anything else to remove any possible feelings of suspicion or distrust towards the more developed countries from which assistance is received. He added: "If membership of the staff of regional institutions were unconditionally open to competent scientists of any community whose welfare depends on the results of its research projects, this would do much to engender an atmosphere of concord and to dissipate any tendency towards national rivalry which may exist." The touch of science, as he put it, can make the whole world kin.

The British Association has elected Sir John Cockcroft as its president for 1961-62.

POSSIBLE FUTURE USE OF BACTERIAL INOCULANTS IN INDIAN AGRICULTURE

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[This article is based on the results of a study tour undertaken for two months during summer 1960 through the various Eastern European countries to learn about bacterial fertilizers where their use is in full swing.]

THE problem of proper fertilizer use exists worldwide, but it is more acute in a country like India where continued cultivation of soil for centuries has resulted in low levels of nitrogen and organic matter. The use of bacterial inoculants may overcome the shortage of plant nutrients thus increasing soil fertility and consequently food production. Before any mass scale step is taken very careful research is needed. In U.S.S.R. and other Eastern European countries the use of bacterial inoculants is already increasing and has resulted in raising the yields of wheat, cotton, lucerne, maize and other vegetable crops.[2,3] Such a venture may prove to be worthwhile in India where the soil productivity is quite low in comparison to U.S.A., Japan, U.S.S.R., Canada, Netherlands, etc.

Increase in soil fertility is directly related to the micro-organisms present in the soil. Activity of these microbes is governed by a set of environmental conditions including pH, moisture, organic matter, temperature, food supply, etc. These soil micro-organisms decompose organic matter, produce "humus" and render the mineral constituents into forms more available for the plant. Hence the introduction of micro-organisms involved in the processes of "nitrogen transformations" and "rhizosphere activity" would be logical in order to raise soil productivity.

Azotobacter spp. is non-symbiotic, aerobic, nitrogen-fixing bacteria which is reported to fix yearly about 40–50 lb. of atmospheric nitrogen per acre.[10] Kostychev[8] was the first to suggest the manufacture of "Azotogen" or "Azotobacterin" from *Azotobacter*. He recommended its use on wheat, rye, oats, barley, potatoes and sugar-beets where its application brought about increases in the crop yields from 10 to 15%.[8] Inoculation of such organisms into soil seems logical but there have been conflicting reports[1] about the inoculation of *Azotobacter* increasing crop yields. Such differences have been explained by Russian workers mostly on the ecological factors and lack of proper agro-techniques when pointed out by the author. In Roumania the report of the "Bacterial Fertilizer Experimental Station"[2] indicated increases of 10% in grain, 65% in straw with the use of "Azotobacterin" alone. When it was applied in combination with N, P, K an increase of 92% in grain and 101% in straw was obtained. The director of this experimental station warned about the proper use of media and number of inoculants. The inoculation of 150–750 million bacteria per c.c. was satisfactory. There have been conflicting reports as to the amount of nitrogen fixed by *Azotobacter* and Meiklejohn[6] emphasized the importance of *Clostridium butyricum* which is non-symbiotic, anaerobic nitrogen-fixer. This bacteria is reported to fix as high as 60 lb. of nitrogen yearly in one acre. If soil conditions were such that both organisms flourished, inoculation of that soil with these organisms might be twice as beneficial.

Rhizobium is a symbiotic nitrogen fixer which inhabits the root nodules of legumes. The quantity of nitrogen fixed by the various species of this organism is reported to be from 60 to 100 lb. in an acre yearly. The increase in yield by the use of inoculation of *Rhizobia*, popularly known as "Legume culture", has shown increases all over the world. In U.S.S.R. and U.S.A. this inoculant is called "Nitragin" and a concentration of 80–100 million *Rhizobia* per gram gave better results. However, locally isolated strains for lupine and lucerne are reported to be effective in Ukraine.[4]

Bacilus megatherium var. *phosphoticum*, a spore-former, is used for the production of "phosphobacterin". This group of bacteria was discovered by Menkina.[7] This bacteria can decompose organic phosphorous compounds present in soil and accumulate phosphorus necessary for plant growth; the heavy inoculum having 6-8 billion bacteria per gram employs kaolin as a carrier. It is distributed to farmers for use with proper instruction to apply at a nominal cost. Roumanian, Bulgarian and Polish workers mentioned the increase in yield by the use of "phosphobacterin" up to 20–40% in many crops. Roumanian workers cautioned that

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strains of *Bacilius megatherium* differed in their capability to produce effective inoculant and in their ability to mineralize the amount of phosphorus. These workers[2] did find 22° to 30° C. to be the optimum temperature for sporulation and that molasses was better than glucose as a source of carbohydrate. The recent repoqts by Smith, Allison and Soulides[9] showed that the use of "phosphobacterin" as soil inoculant would be beneficial for vegetable crops. Where commercial fertilizers are available in abundance it would not be beneficial to accelerate the oxidation of soil organic matter in order to release phosphorus, but in India this situation is reversed and for this reason these bacteria may increase the amount of available phosphorus.

Silicobacteria alexendrov is used to produce "silicobacterin" which is used to increase the availability of potassium in soil. This bacteria is autotrophic and derives its energy from alumino-silicate of the soil. This organism was also isolated by Alexendrov in 1940.[2] The inoculation, having 40 million bacteria per gram, showed increases of 27 – 28% in exchangeable K.

There is also another bacterial inoculant known as "Lactobacterin" which is used to hasten the silage-making, and is produced from *Lactobacillus* spp. The use of "lactobacterin" decreased the spoilage of silage caused by moulds on the walls of silo and improved the palatability of silage.[2]

Use of bacteria in quick retting of fibres, production of mycorrhiza and mycelium of mushroom (*Psalliota compestris*) have shown encouraging results and in the very near future would be in manufacture stage. In increasing the efficiency of such inoculants the polyculture has proved more useful, mixed fertilizers brought about increase in yields of tomato, potato and other field crops.

The mechanism of the action of "bacterial fertilizers" is discussed in more detail by Cooper[5], however, it is still a matter of speculation. Several hypotheses are put forward by Cooper,[5] i.e., a provision of growth factors, destruction of soil toxins, acceleration of normal soil processes, stimulation of other microbes and antagonism towards other pathogens. All these hypotheses are plausible but there is a growing need to establish the validity of them. An application of 50 p.p.m. of gibrel (a potassium salt of gibberellic acid) increased the activity of autotrophes involved in sulfur oxidation and nitrification in 9 different Oregon soils.[5] These results suggest that the "bacterial inoculants" may liberate substances which may increase the efficiency as well as the number of the bacteria involved in such processes.

It can be said in summarization that after a tour of two months in the countries where "bacterial inoculants" are being used, the writer found a widespread faith in their ability to increase the yields of many crops. This confidence was exhibited by the farmers on the collective farms as well as the scientists engaged in their production and developments and agro-technologists who test their effectiveness in field trials and other research workers. However, some scientists were hesitant to go along with their "wonder effect" and described them only as supplemental to the mineral fertilizers. Whatever the pros and cons may be of their application, their popularity suggests a definite need of research on "bacterial inoculants", and their widespread use in communist countries should not be discarded as mere "political stunts", "lack of proper statistics", "faulty technique" and "poor experimentation", etc. The scientists with an "open mind" should explore this newly developed field which can bring benefits in a country where the commercial fertilizers are not readily available. Their application alone or in combination with mineral fertilizers, use of proper media for their maximum efficiency, the right strength of inoculation and the proper strains responsible for maximal activity should be emphasized and explored further.

ACKNOWLEDGEMENT

The author expresses thanks to the University of Baghdad for providing the facilities which made this tour possible through these countries. Further, grateful thanks are due to the interpreters without whose genuine help this tour could not have been useful. Also my thanks are due to my colleagues Drs. J. D. Beaton and K. F. Nielsen for the criticism and suggestions to improve the manuscript.

1. Allison, F. E., *Soil Sci.*, 1947, **64**, 413.
2. Anonymous,. *Lucari Stiintifice (Report of the Bacterial Fertilizer Experimental Centre)* Ministry of Agriculture, Bucharest (Roumania), 1959.
3. Askinazi, D. L., *Soviet Soil Sci.* (English Trans.), 1958, **4**, 372.
4. Chandra, P. and Bollen, W. B., *Appl. Microbiol.*, 1960, **8**, 31.
5. Cooper, R., *Soils and Fertiliser*, 1959, **22**, 327.
6. Meiklejohn, J., *Trans. Sixth Int. Cong. Soil Sci.*, 1956, **3**, 243.
7. Menkina, R A., *Microbiologiya*, 1950, **19**, 4.
8. Potkov, L., *A World We do not See*, Foreign Languages Pub., Moscow, 1957
9. Smith, J. H., Allison, F. E. and Soulides, T., *Soil Sci. Soc. Amer. Proc.*, 1961, **25**, 109.
10. Waksman, S. A., *Soil Microbiology*, John Wiley & Sons, New York, 1952.

CYTOGENETICS OF THE INTERGENERIC HYBRID, *VACCARIA GRANDIFLORA* × *SAPONARIA VACCARIA*

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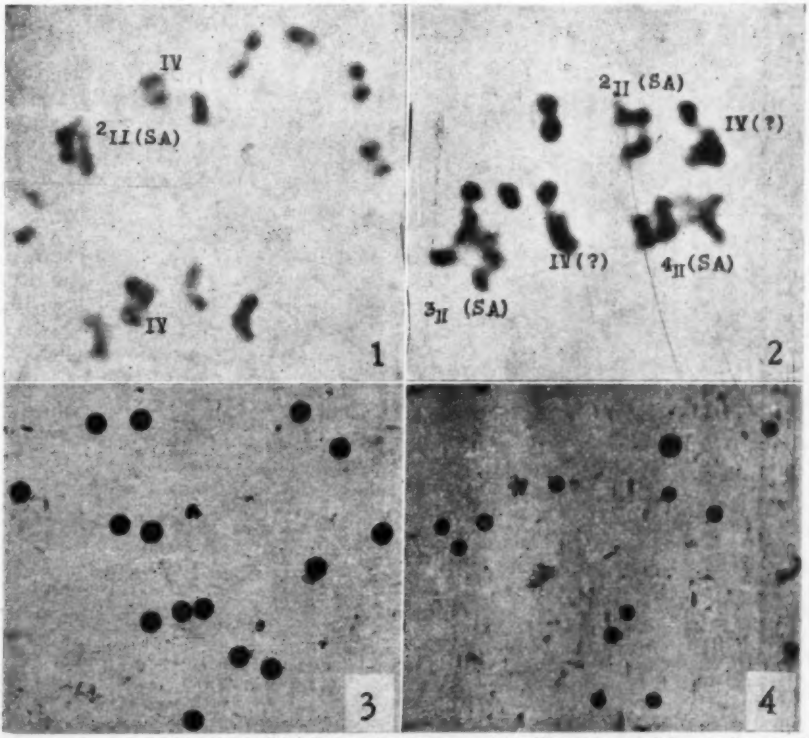
EXCEPT for Graminæ and Orchidaceæ, intergeneric hybridization in angiosperms is very rare. If such hybrids are fertile and involve plant species properly placed in two different genera, it is logical to conclude about their close genetic relationship and, as such, validity of one of these becomes questionable. Such a situation is aptly true of the present hybrid.

Saponaria vaccaria Linn. (Caryophyllaceæ) is a very common winter-annual weed of cultivation in the North-Western India and Khoshoo[1] found $n = 15$ in this. This finding raised a measure of suspicion about the biosystematic identity of the species, because all the other species of the genus *Saponaria* possess $n = 14$.[2,3] In strong contrast to this, the species of the allied genus *Vaccaria*, possess exclusively $n = 15$.[2,3] In order to unravel the genetic relationships of *Saponaria vaccaria*, it was crossed extensively with members of the genera *Vaccaria* and *Saponaria*. While the details of these results, and implications thereof, of these experiments will appear elsewhere, it is of interest to report here on one of the hybrid combinations, *Vaccaria grandiflora* Jaub. and Spach. × *Saponaria vaccaria* Linn. Both these possess $2n = 30$ and $n = 15$. Karyotype in both is nearly similar and contains 6 sat-chromosomes. This fact fits very well with the earlier conclusion of Khoshoo[1] that the Silenoideæ with $n = 15$ are "cryptic polyploids", being at hexaploid level with $x = 5$. This is further confirmed by the presence of multivalent and secondary associations (Fig. 1). However, both the parents are perfectly fertile (Fig. 3). During meiosis the hybrid shows a reduced degree of multivalent formation but there is pronounced increase in



FIGS. 1–4. Figs. 1–2. Metaphase I in *Saponaria vaccaria* and F_1 *Vaccaria grandiflora* × *S. vaccaria*. Both possess $n = 15$ and show multivalents and secondary associations (*S.A.*), particularly in the latter, × 3,600. Figs. 3–4. Pollen grains of *S. vaccaria* (94% stainable) and the F_1 (30%), × 100.

secondary associations (Fig. 2). Possibly some of the secondary associations are disjoined multivalents. These features reveal that there is not only good deal of homology between the chromosomes of the two parents, but there also exists a measure of structural hybridity. The anaphases are perfectly clean but the fertility is reduced (30% in pollen, Fig. 4; and 37% in seeds), which indicates that disharmonious combinations are formed as a result of the recombination between the parental chromosomes. Possibly there is good deal of cryptic structural hybridity and we are attempting a detailed pachytene analysis to unravel the extent and nature of such hybridity.

The F_1, F_2 and F_3 populations were raised and these are not only healthy and vigorous, but what is important, there is an increase in fertility from F_1 to F_3 (37 to 70% in seeds).

While *S. vaccaria* possesses no barriers to gene exchange at any stage when crossed with ***V. grandiflora***, it, however, is strongly isolated genetically from other members of the genus *Saponaria* possessing $n = 14$ (Fig. 5). This is

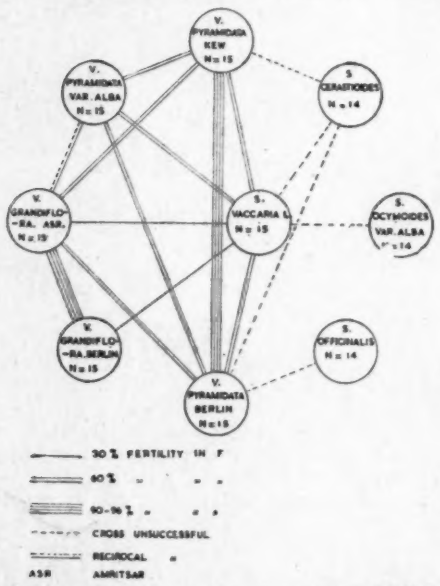

V. PYRAMIDATA KEW N = 15
V. PYRAMIDATA VAR. ALBA N = 15
S. CRASSIOIDES N = 14
V. GRANDIFLORA ASR. N = 15
S. VACCARIA L. N = 15
S. OCYMOIDES VAR. ALBA N = 14
V. GRANDIFLORA BERLIN N = 15
S. OFFICINALIS N = 14
V. PYRAMIDATA BERLIN N = 15
30 % FERTILITY IN F
60 % " "
90-96 % " "
CROSS UNSUCCESSFUL
RECIPROCAL "
ASR AMRITSAR

FIG. 5. Crossing polygon showing the genetic affinity of *Saponaria vaccaria*.

a very strong genetic proof for the fact that even though the name *S. vaccaria* Linn. is very commonly used in floras, monographs and research papers all over the world, in genetical sense it is actually a member of genus *Vaccaria*. This conclusion is further corroborated by a critical morphological as well as chemical analyses of *S. vaccaria*. In all these features it resembles very closely the genus *Vaccaria*, rather than the genus *Saponaria*, a situation not accepted by Linnaeus.[4]

The genera *Vaccaria* and *Saponaria* as reconstituted now possess exclusively $n = 15$ and $n = 14$ respectively. Morphologically the former has inflated and 5-keeled calyx, non-appendaged petals and spherical seeds; while the latter has cylindrical and keelless calyx, appendaged petals and kidney-shaped seeds. Furthermore, *Vaccaria* contains traces of Saponin, while *Saponaria* possesses it in copious amount.

In view of the fertile hybrids and lack of barriers to gene exchange between the two parents, speciation between the reconstituted genus *Vaccaria* poses an interesting problem. The present investigations reveal that the two species (*i.e.*, *S. vaccaria* and *V. grandiflora*) are separated on somewhat minor taxonomic characters. A genetical analysis of F_2 and F_3 reveals that there is strong linkage between the characters separating the two species. Speaking evolutionally there is a strong "coherence"[5] between the taxonomic characters. The mode of inheritance of such characters is complex. It may be pointed out that it is such characters that are of real taxonomic value because in spite of hybridization they tend to segregate together. To put it simply, the more the coherence between the taxonomic differences, the more reliable and useful these are to the taxonomist.

In the end, it may be pointed out that this is an addition to the few examples of intergeneric hybrids in dicotyledons,[6] where generic transfers have been made or are advocated on the basis of combined morphological, cytological and genetical study. Furthermore, such methods not only help in an understanding of the evolutionary processes, but also help in building classification which reflects the true evolutionary relationships of the taxa involved.

Our thanks are due to Prof. P. N. Mehra for facilities and Mr. Narinder Shah for help in making Fig. 5.

1. Khoshoo, T. N., *Nature*, 1960, **186**, 412.
2. Darlington, C. D. and Wylie, A. P., *Chromosome Atlas of Flowering Plants*, London, 1955.
3. Cave, M. S., *et al.*, *Index to Plant Chromosome Numbers*, Calif. Bot. Soc. and Univ., North Carolina Press, 1956–59 and Supplement.
4. Linnaeus, C., *Species Plantarum*, Upsal., 1762.
5. Clausen, J. and Hiesey, W. M., *Proc. Nat. Acad. Sci.* (U.S.A.), 1960, **46**, 494.
6. Rollins, R. C., *Chronica Botanica*, 1955, **14** (3), 133.

NOTE ON THE QUALITY OF GROUNDWATER FOR IRRIGATION IN THE SUBMONTANE TRACTS AND INTERMONTANE VALLEY OF UTTAR PRADESH

K. V. RAGHAVARAO AND T. S. RAJU

Exploratory Tubewells Organisation, Ministry of Food and Agriculture, Division IV, Roorkee

EXPLORATORY drilling operations were successfully carried out for the construction of heavy duty water wells for irrigational purposes in the year 1959-60 in the *Bhabar* formations of Nainital District and in the intermontane valley of Dehra Dun District (Doon Valley).

Geologically the *Bhabar* formations are constituted of unconsolidated sand-boulder and clay-boulder beds and the Doon alluvial fill is made up of clays, sands and gravels associated with boulders, cobbles and pebbles of limestone, and quartzite.

For the study under consideration, water samples have been obtained from the successfully completed wells, from water-bearing formations occasionally as deep as four hundred and fifty feet below land surface. The studies are based on the latest methods adopted by the U.S. Department of Agriculture, using the "Sodium Adsorption Ratio" or SAR for studying the suitability of water for irrigation.

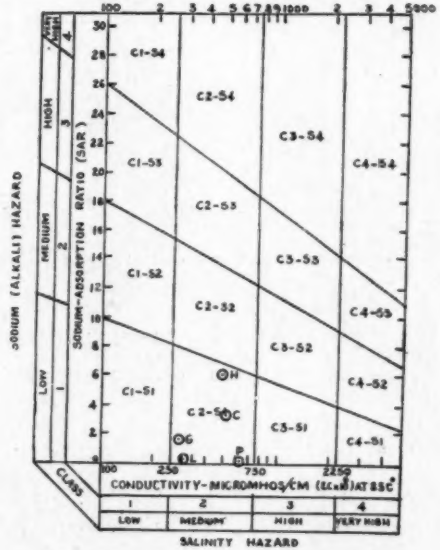


DIAGRAM FOR USE IN INTERPRETING THE ANALYSIS OF IRRIGATION WATER.
G-GORAPARAV L-LALKUA C-CHANDINI
H-HIMMATPUR P-PREMNAGAR

In plotting the points on the diagram the specific conductance is taken as TDS and for irrigation use, termed as "Salinity Hazard". The SAR values are computed from the analyses of well-waters and plotted on the vertical scale. Table I shows that water samples have been taken from set geological horizons.

From the locations of the points on the diagram (Class C2-S1), the following conclusions have been drawn :—

(1) Water wells located within the *Bhabar* and close to the foothills zone of the Himalayas, tap groundwater which is significantly low in salinity and sodium hazards and as such the water can be used on all soils and for most crops. The irrigation water from such wells shows that the calcium and magnesium ions exceed sodium ions slightly. The waters are useful for maintaining good tilth and permeability of the soils.

(2) Though all the values of SAR are generally well below ten as indicated in the diagram, there is a tendency for the groundwaters close to the seepage or spring line zone (*i.e.*, at the border of *Bhabar* and *Tarai*) to present a sodium hazard problem. Also the analyses indicate that sodium ions exceed the calcium and magnesium ions in quantity. In view of this, for any groundwater lift irrigation projects, the study of soils in this belt *vis-a-vis* chemical composition of groundwaters, may be desirable.

(3) The study of the usefulness of groundwaters, in the intermontane valley, for irrigation throws light on salinity hazard which needs study on the crop patterns. The high calcium content of the groundwater in the Doon Valley may be attributed to the geological setting of the valley, which borders the Krol limestone belt of Himalayas with its alluvial fill rich in gravels and pebbles of limestone. The soils are likely to be enriched in their permeability from the groundwaters, if applied for irrigational purposes. The sodium hazard is thereby minimised in this belt.

The studies are initiated for the first time in the submontane and intermontane tracts of Himalayas and bears significance in their future application to the entire *Bhabar* belt and intermontane valleys extending from Kashmir to Assam.

The authors wish to place on record their sincere thanks to Shri D. Mehta, Chief Engineer, E.T.O., New Delhi, and Shri M. P. Pandey, Executive Engineer, E.T.O., Roorkee, for the keen interest they have evinced in the work.

TABLE I

Analyses of water samples from geological zones at various depths

Sl. No.		Well	Geological horizon	Depth of the zone (in feet below land surface)	Electrical conductivity in micromhos/cm. at 25°C.	Chemical analysis (in parts per million)						
						Total dissolved solids	pH	Hardness as $CaCO_3$	Bicarbonate HCO_3	Iron	Silica SiO_2	Calcium
1		2	3	4	5	6	7	8	9	10	11	12
1	District Nainital	Goraparav* (29°10′ : 79°32′)	*Bhabar* (well placed in *Bhabar*)	350′–496′	278‡	189	9·3	18·0	79·3	..	..	8·8
2		Lalkua† (29°05′:79°31′)	*Bhabar* (2½ miles N. of seepage or spring line)	138′–148′ 163′–203′ 223′–253′ & 268′–278′	302	205	7·5	163·0	186·0	Trace	25·6	20·4
3		Tanakpur* (29°04′ : 80°03′)	*Bhabar* (well in *Bhabar*)	70′– 90′ 110′–212′	300	..	8·2	6·0	219·06	..	..	..
4		Chandni* (29°01′ : 80°04′)	*Bhabar* (close to the southern extremity of *Bhabar*)	67′–168′	515‡	350	8·95	18·0	183·0	..	..	8·0
5		Himmatpur* (29°20′:79°03′)	*Bhabar* (close to the seepage or spring line)	142′–207′	480	325‖	8·50	18·0	251·10	..	..	17·60
6	District Dehra Dun	Premnagar† (30°20′:77°58′)	Doon alluvial fill	150′–170′ 185′–235′	612	418	7·5	344·0	329·0	..	19·60	96·34
7		Forest Research Institute‡ (30°20′:78°00′20″)	do.	280′–340′	..	500	..	350·0	..	..	..	..

Sl. No.		Well	Chemical analysis (in parts per million)								Remarks
			Magnesium	Potassium	Sodium	Sulphate	Chloride	Sodium** adsorption ratio (SAR)	Calcium + Magnesium Ions ($Ca^{++}+Mg^{++}$)	Sodium Ions (Na^{+})	
			13	14	15	16	17	18	19	20	21
1	District Nainital	Goraparav* .. (29°10′:79°32′)	17·76	2·6	35·6	18·4	8·0	1·589	1·8987	1·5486	$Ca^{++}+Mg^{++} > Na^{+}$
2		Lalkua† (29°05′:79°31′)	27	1·8	6·2	17·0	8·1	0·212	3·239	0·2397	$Ca^{++}+Mg^{++} > Na^{+}$
3		Tanakpur* .. (29°04′:80°03′)	..	..	..	Trace	20·0	..	..	..	Analysis incomplete
4		Chandni* .. (29°01′:80°04′)	26·0	1·27	90·00	Nil	20·0	3·467	2·5374	3·9150	$Ca^{++}+Mg^{++} < Na^{+}$
5		Himmatpur* .. (29°20′:79°03′)	2·40	5·04	104·0	29·8	15·0	6·169	1·0755	4·524	$Ca^{++}+Mg^{++} < Na^{+}$
6	District Dehra Dun	Premnagar† .. (30°20′:77°58′)	25·2	1·0	6·69	79·0	11·3	0·157	6·880	0·2910	$Cr^{++}+Mg^{++} > Na^{+}$
7		Forest Research Institute‡ .. (30°20′:78°00′30″)	..	..	..	..	..	..	..	..	Analysis incomplete

* Analysis carried out in the laboratories of Indian Agricultural Research Institute, New Delhi.

† Analysis carried out in the laboratories of the Geological Survey of India, Calcutta.

‡ Analysis furnished by the Forest Research Institute and Colleges, Dehra Dun.

‡‡ Computed from the determined TDS value factor 0·678 derived from the chemical analysis of Lalkua water sample.

‖ Computed from the determined electrical conductivity value and the factor 0·678 derived from the chemical analysis of Lalkua water sample.

** $SAR = \dfrac{Na^{+}}{\sqrt{\dfrac{Ca^{++}+Mg^{++}}{2}}}$

LETTERS TO THE EDITOR

HIGH RESOLUTION PROTON MAGNETIC RESONANCE SPECTRUM OF COUMARIN

An analysis of the nuclear magnetic resonance spectrum of a system containing 4 nuclei of the type ABCD (in the notation of Pople, Bernstein and Schneider[1]) is quite complicated and does not seem to have been attempted so far except under certain approximations.

Such a system is encountered in coumarin molecule (Fig. 1) for the protons attached to the carbon atoms numbered 5, 6, 7, 8. The other two protons present in the molecule give rise to a spectrum of the AB type. Herein we report the proton resonance spectrum of coumarin which has been fully analysed both for ABCD and AB groups.

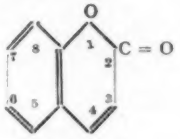


FIG. 1

The spectrum (Fig. 2) was recorded on a Varian associates' High Resolution Spectrometer operating at 60 Mc./s. The positions of various peaks were measured relative to cyclohexane as an internal standard with the usual side band technique. The resolution was of the order of 0·5 cps; the line separations could be measured with an accuracy of 0·5 cps. Solution of coumarin (100% pure Rhodia) was made in tetrahydrofuran (E. Merck) and nitrogen gas was bubbled through it to remove any dissolved oxygen before using the sample for recording the spectrum. A spectrum of this molecule observed at 30 Mc./s. has been reported earlier[2]; however, the resolution achieved in the present case is far better and is, therefore, amenable for detailed analysis.

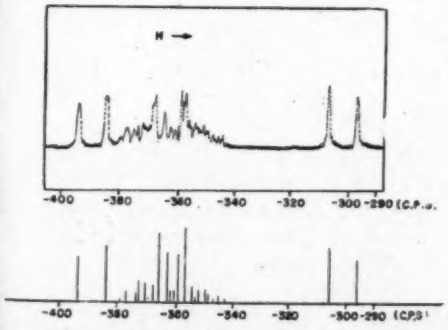


FIG. 2. Observed and calculated spectra of coumarin (frequencies are relative to cyclohexane as an internal standard).

From the intensities and the line separations, the first two and the last two lines forming a quartet can be identified as arising from the protons attached to carbon atoms in positions 3 and 4. The first doublet from the left probably arises from the proton in 4 position as it is β to the carbonyl group and α to the phenyl group. The quartet was analysed on the AB theory and the following values have been obtained for the chemical shifts (δ) for the two protons (relative to cyclohexane) and the spin coupling constant (J_{34}).

$\delta_3 = -301{\cdot}4$ cps. ($-5{\cdot}03$ p.p.m.);
$\delta_4 = -389{\cdot}0$ cps. ($-6{\cdot}48$ p.p.m.);
$J_{34} = 9{\cdot}8$ cps.

The remaining lines in the spectrum have been ascribed to the protons of the ABCD type.

The secular equation for this system set up on the basis of the usual Hamiltonian:

$$H = \frac{1}{2\pi}\sum_i \gamma_i H_i I_z(i) + \sum_{i<j} J_{ij}\, I_i . I_j$$

gets factorised into two 1×1, two 4×4 and one 6×6 matrices. The eigenvalues and the orthonormalised eigenvectors corresponding to the 4×4 and 6×6 matrices were obtained using the T.I.F.R. digital computer, for different trial values of the parameters involved in the analysis. The following set of parameters gives the best fit between the calculated and the observed spectra. The theoretical spectrum is shown in Fig. 2 for comparison:

$\delta_5 = -368{\cdot}9$ cps. ($-6{\cdot}15$ p.p.m.);
$\delta_6 = -354{\cdot}0$ cps. ($-5{\cdot}90$ p.p.m.);
$\delta_7 = -367{\cdot}8$ cps. ($-6{\cdot}13$ p.p.m.);
$\delta_8 = -352{\cdot}6$ cps. ($-5{\cdot}88$ p.p.m.);
$J_{56} = 8{\cdot}5$ cps.;
$J_{57} = 2{\cdot}0$ cps.;
$J_{58} = 0$ cps.;
$J_{67} = 8{\cdot}6$ cps.;
$J_{68} = 1{\cdot}8$ cps.;
$J_{78} = 8{\cdot}5$ cps.

The details of the theoretical calculations of the analysis of ABCD type spectra will be

published elsewhere along with the analysis of the spectra of substituted coumarins; the results give interesting information regarding the resonance in coumarin, the nature of the double bond between carbon atoms in positions 3 and 4, and the effects of the substituents on the electron density at various carbon atoms in the ring.

The authors wish to thank Dr. R. Narasimhan and Sri. M. M. Dosabhai of the Computer Section of the Tata Institute of Fundamental Research for their help in running our matrices on the computer. They are also thankful to Professor S. S. Dharmatti for his constant encouragement and guidance during this investigation.

Tata Inst. of Fundamental Research, and Atomic Energy Establishment, Trombay, Bombay, *July* 8, 1961.

G. Govil.
C. R. Kanekar.
C. L. Khetrapal.
Y. P. Virmani.

1. Pople, J. A., Schneider, W. G. and Bernstein, H. J., *High Resolution Nuclear Magnetic Resonance*, McGraw-Hill Publication, 1958, p. 98.
2. Dharmatti, S. S., Govil, G., Kanekar, C. R. and Virmani, Y. P., *Colloque De Pise*, 1960, p. 492.

POTENTIAL CONSTANTS OF CYCLOPROPANE AND CYCLOPROPANE-d_6

Cyclopropane is a molecule belonging to the point group D_{3h} with the three carbon atoms lying in a plane and two H or D atoms attached to each one of the carbon atoms. The vibrational assignments have been proposed for the various fundamental frequencies by Lord and Baker.[1] Some of the fundamentals are inactive both in infra-red and Raman spectra. Estimated values were given for these with the help of overtones and the product rule.

The evaluation of the force constants for the vibrations (stretching, bending and twisting—in and out of plane) will enable us to fix up the inactive and unobserved frequencies with a fair degree of certainty. Using the A'_1 and A''_1 frequencies of an earlier assignment,[2] Saksena[3] worked out a few potential constants by employing an approximate valence force field.

Using Wilson's F—G matrix method[4] and a general valence force field, the force constants are now evaluated after setting up the F and G matrices for both the Cyclopropane and Cyclopropane-d_6 molecules. The following molecular data[5] are employed for the calculations: d (C—C) = 1·53 Å, r (C—H) = 1·09 Å, θ (H—C—H) = 116° 56′. The angle α (H—C—H) is calculated from the geometry of the molecule.

Table I lists all the numerical values for the force constants given in units of 10^5 dynes/cm. The angles are multiplied by $\sqrt{rd}$ so that the internal co-ordinates are all of the same dimension of length.

Table I

	Cyclopropane	Cyclopropane-d_6
f_d	4·6534	4·2205
f_{dd}	−0·1115	0·0097
f_r	5·1706	5·2308
f_{rr}	0·0898	0·1260
f_{dr}	0·0722	0·1238
f_α	0·3154	0·3218
$f'_{\alpha\alpha}$	0·0809	0·0817
$f''_{\alpha\alpha}$	0·0458	0·0529
$f'''_{\alpha\alpha}$	0·1344	0·1342
$f_{d\alpha}$	0·0231	0·0785
$f'_{d\alpha}$	0·0799	0·0965
$f_{r\alpha}$	0·3718	0·2714
$f'_{r\alpha}$	−0·2664	−0·2335

$f'_{\alpha\alpha}$, $f''_{\alpha\alpha}$, $f'''_{\alpha\alpha}$ refer respectively to the interaction of two α's having a common C—H bond, a common C—C bond and no common bond respectively. $f_{d\alpha}$, $f'_{d\alpha}$ refer to d, α interactions having a common C—C bond and no common bond respectively. A similar notation for $f_{r\alpha}$, $f'_{r\alpha}$ is followed.

The inactive fundamentals in A''_1 and A'_2 types as well as the CH_2 twisting frequency (which could not be directly observed) are calculated using the above data and are reported in Table II.

Table II

Vibration type	C_3H_6		C_3D_6	
	Calculated (cm.$^{-1}$)	Estimated (cm.$^{-1}$) (Baker and Lord)	Calculated (cm.$^{-1}$)	Estimated (cm.$^{-1}$) (Baker and Lord)
A''_1	693·1	975	489·1	790
A'_2	561·8	1125	475·0	800
E''	1210	1050	893	835
(CH_2 twisting frequency)				

Details will be published elsewhere.

Department of Physics, S.V. University College, Tirupati, *July* 3, 1961.

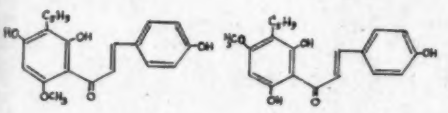
P. Babu Rao.
K. Sreerama Murty.

1. Baker, A. W. and Lord, R. C., *J. Chem. Phys.*, 1955, **23**, 1636.
2. Herzberg, G., *Infra-red and Raman Spectra*, D. Van Nostrand Company Inc., New York, 1945.

3. Saksena, *Proc. Ind. Acad. Sci.*, **1939, 10A, 449.**
4. Wilson, E. B., Jr., *J. Chem. Phys.*, **1939, 7, 1041 ; 1941, 9, 76.**
5. Pauling, L. and Brockway, L. O., *J. Am. Chem. Soc.*, **1937, 59, 1223.**
Linnett, J. W., *J. Chem. Phys.*, **1938, 6, 692.**
Dunitz, J. C. and Schomaker, *J. Chem. Phys.*, **1952. 20, 1703.**

CONSTITUTION OF XANTHOHUMOL

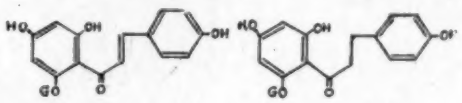
XANTHOHUMOL is a special type of chalkone isolated from hops resin by Verzele and co-workers.[1] They showed that it had the molecular formula $C_{21}H_{22}O_5$, one methoxyl and three hydroxyl groups and a dimethyl allyl group and proposed structure (I) for it. Vandewalle and Verzele[2] provided confirmatory evidence. Later Hubner *et al.*[3] considered that the alternative structure (II) would be the correct one. The cause of this disagreement is due to the difference in the behaviour of the two analogous ketones, 2 : 4 : 6-trihydroxy-1-isobutyryl 3-methyl benzene and 2 : 4 : 6-trihydroxy-1-acetyl 3-(3-methylbut-2-enyl) benzene towards diazomethane. The former yields the 4-methyl ether and the latter the 6-methyl ether. The matter has been clarified in the recent paper of Vandewalle and Verzele[4] who have provided more evidence in favour of structure (I). A point that could be mentioned in further support of their structure is as follows. So far no stable chalkone has been found to occur in nature having two free hydroxyl groups in the 2' : 6' positions. Experiments have shown that this structure is unstable (see Narasimhachari and Seshadri[5]). Since Xanthohumol is a fairly stable chalkone comparable with butein (Seshadri),[6] it should have the methoxyl in one of the above two positions. Of the two, the 6-position, is the only possibility.



I II

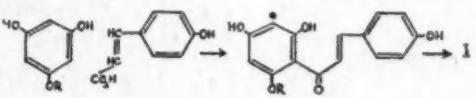
Xanthohumol is extraordinary among the natural chalkones in having a methoxyl in the 6-position and an isoprene unit in the 3-position. Somewhat analogous will be the occurrence of 6-glucosidoxy chalkone, isosalipurposide (III) and the 6-glucosidoxy dihydrochalkones, phloridzin (IV) and asebotin (V).

A discussion of the evolution of these glucosides has been given earlier[7-8] and the considerations hold good even for the 6-methoxy compounds. Probably the most satisfactory suggestion will be the combination of a phloroglucinol methyl ether or glucoside as the C_6 unit with cinnamic acid derivative as the C_9 unit. Then the chalkone will be stable enough to occur free and



III IV R = H
G = glucose unit V R = CH_3

the newly entering C_5 unit can get in only in the 3-position which is the active nuclear position in the hydroxy ketone structure for nuclear alkylation (see for collected literature Jain and Seshadri).[9] The stages are indicated below :



R = CH_3 or glucose unit

Chemistry Department, M. R. PARTHASARATHY.
Delhi University, T. R. SESHADRI.
Delhi-6, *July* 5, 1961.

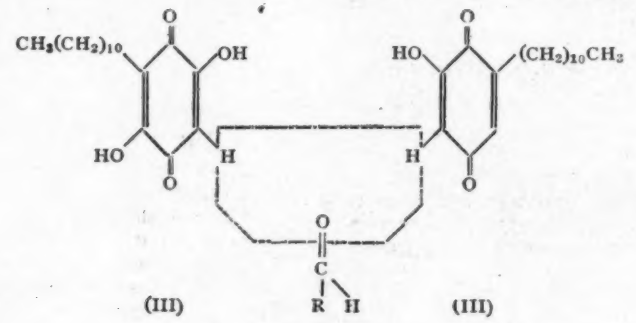
1. Verzele, M., Stockx, J., Fontijn, F. and Anteunis, M., *Bull. Soc. Chim. belges.*, **1957, 66, 452.**
2. Vandewalle, M. and Verzele, M., *Ibid.*, **1959, 68, 711.**
3. Hubner, H. and Riedl, W., *Ber.*, **1960, 93, 312.**
4. Vandewalle, M. and Verzele, M., *J.C.S.*, **1961, 1021.**
5. Narasimhachari, N. and Seshadri, T. R., *Proc. Ind. Acad. Sci.*, **1948, 27A, 223** and subsequent papers.
6. Seshadri, T. R., *Scientific Proceedings, Royal Dublin Society*, **1956, 27, 77.**
7. —, *Proc. Ind. Acad. Sci.*, **1950, 32 A, 372.**
8. —, *Ann. Review of Biochem.*, **1951, 20, 508.**
9. Jain, A. C. and Seshadri, T. R., *Jour. Sci. Ind. Res.*, **1955, 14 A, 231.**

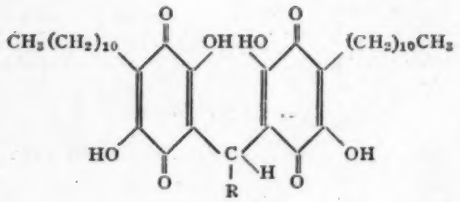
SOME REACTIONS OF EMBELIN

AN earlier note[1] deals with the isolation and constitution of vilangin, as methylene-bis (2 : 5-dihydroxy-4-undecyl-3 : 6-benzoquinone) and its synthesis accomplished by condensing embelin (III) with formaldehyde. This reaction is capable of further extension and embelin could be expected to condense with various aldehydes. Kaul *et al.*[2] have studied these condensations in some detail at a time when the constitution of embelin and its synthesis were not known. Several aldehydes have now been condensed

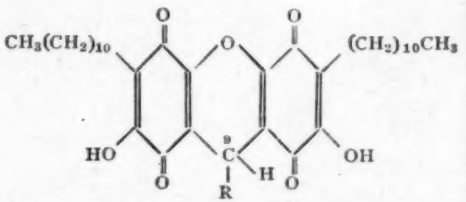
with embelin to give compounds of vilangin type (I) and anhydrovilangin type (II), and these condensation products were designated by us as analogues of vilangin and anhydrovilangin respectively.

From a study of the data presented, the following conclusions could be drawn. While with formaldehyde, only one product, vilangin, was obtained with acetic, propionic and benzaldehydes, both the vilangin and anhydrovilangin





(I)



(II)

TABLE I

Aldehyde		Product	Colour
Formaldehyde	..	Vilangin	Orange yellow
Acetaldehyde	..	(*a*) Methylvilangin	Pale orange
		(*b*) 9-Methylanhydrovilangin	Orange red
Propionic aldehyde	..	(*a*) Ethylvilangin	Pale grey
		(*b*) 9-Ethylanhydrovilangin	Orange red
Benzaldehyde	..	(*a*) Phenylvilangin	Orange yellow
		(*b*) 9-Phenylanhydrovilangin	Orange
Phenylacetaldehyde	..	9-Benzylanhydrovilangin	do.
Cinnamic aldehyde	..	9 (β-Phenylvinyl) anhydrovilangin	Golden yellow
p-Dimethylamino benzaldehyde	..	9 (4′-Dimethylaminophenyl)anhydrovilangin	Scarlet red
p-Hydroxy benzaldehyde	..	9 (4′-Hydroxyphenyl) anhydrovilanign	Orange
p-Methoxy benzaldehyde	..	9 (4′-Methoxyphenyl) anhydrovilang n	Orange red
Salicylaldehyde	..	9 (2′-Hydroxyphenyl) anhydrovilangin	Scarlet
Ortho-methoxy benzaldehyde	..	9 (2′-Methoxyphenyl) anhydrovilangin	Deep orange
3 : 5-Dinitrobenzaldehyde	..	9 (3′ : 5′-Dinitrophenyl) anhydrovilangin	Deep purple
3 : 4-Methylenedioxy benzaldehyde	..	9 (3′ : 4′-Methylenedioxyphenyl) anhydrovilangin	Orange red
Vanillin	..	9 (3′-Methoxy-4′-hydroxyphenyl) anhydrovilangin	do.
Veratraldehyde	..	9 (3′ : 4′-Dimethoxyphenyl) anhydrovilangin	Orange yellow

Table I gives a summary of the aldehydes used for this condensation and the nature of the products obtained thereof.

analogues were obtained, and with increasing molecular weight of the aldehydes, only products of type (II) were obtained. It is interesting

to note that no condensation took place with aliphatic and aromatic ketones.

Fuller details would be published elsewhere.

Dept. of Chem., V. VENKATESWARLU.
Andhra University, CH. BHEEMASANKARA RAO.
May 17, 1961.

1. Bheemasankara Rao, Ch. and Venkateswarlu, V., *Curr. Sci.*, 1961, **30**, 259.
2. Kaul, R., Ray, A. C. and Dutt, S., *J. Ind. Chem. Soc.*, 1931, **8**, 231.

MERCURATION OF COMPOUNDS CONTAINING REACTIVE METHYLENE GROUP BY MEANS OF MERCURIC SALTS OF ORGANIC ACIDS

NAIK AND SHAH,[1,3] Naik and Patel[2] mercurated ethyl acetoacetate, diethyl malonate and their substituted amides, by using mercuric chloride, mercuric acetate and mercury acetamide. But it appeared from references to literature that different mercuric salts, derived from substituted and unsubstituted organic acids, have not been systematically utilised for mercuration of compounds containing reactive methylene group. In the present investigation mercury formate, acetate, propionate, butyrate, isovalerate (isopropylacetate), monochloracetate, trichloracetate have been used to mercurate ethyl acetoacetate.

The mercury salts required for mercuration of ethyl acetoacetate have been prepared by a new method involving the interaction of mercury acetamide with appropriate acids.

$$(CH_3CONH)_2Hg + 2\,RCOOH \rightarrow (RCOO)_2Hg + 2\,CH_3CONH_2$$

In the above equation and in the equations that follow,

$R = H,\ CH_3,\ C_2H_5,\ C_3H_7,\ C_4H_9,\ CH_2Cl,\ CCl_3$

The mercurated products of ethyl acetoacetate have been prepared by treating the ester with mercury salts in aqueous solution maintaining continuous stirring.

$$2(RCOO)_2Hg + CH_3COCH_2COOC_2H_5 \longrightarrow \begin{matrix} RCOOHg \\ RCOOHg \end{matrix}\!\!>\!C\!<\!\begin{matrix} COCH_3 \\ COOC_2H_5 \end{matrix} + 2RCOOH.$$

The characteristic properties of these compounds are given in Table I.

On passing slowly H_2S gas into a hot alcoholic suspension of the substance a black precipitate of HgS was quantitatively obtained.

The influence of different acidic groups attached to mercury on the stability of C-Hg bond has been determined by interacting the mercurated products with alcoholic potassium iodide and estimating the amount of alkali liberated in specific time. The reaction involved therein is as under :—

$$\begin{matrix} RCOOHg \\ RCOOHg \end{matrix}\!\!>\!C\!<\!\begin{matrix} COCH_3 \\ COOC_2H_5 \end{matrix} + 2KI + 2H_2O \rightarrow CH_3COCH_2COOC_2H_5 + 2RCOOHgI + 2KOH$$

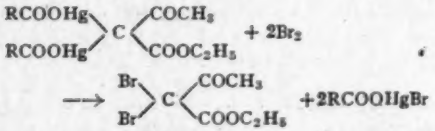
It is found that the C-Hg bond becomes weaker as we pass from acetoxy through propioxy to butyroxy. On the other hand C-Hg bond becomes relatively stable when C-Hg bond in isopropylacetoxy-group is present. The monochloracetoxy and trichloracetoxy groups bring about the weakening of C-Hg bond.

TABLE I

Sl. No.	Name	Formula	Colour change	Decomposition temperature	Analysis	
					Found	Calculated
1	Ethyl diformyloxy mercury acetoacetate	$C_8H_{10}O_7Hg_2$	White-grey (due to liberation of mercury)	..	Decomposes in presence of light	Hg 64·75%
*2	Ethyl diacetoxy mercury acetoacetate	$C_{10}H_{14}O_7Hg_2$	White to yellow to brown	245° C.	Hg 61·9	Hg 61·97%
3	Ethyl dipropioxy mercury acetoacetate	$C_{12}H_{18}O_7Hg_2$	do.	225° C.	Hg 59·22	Hg 59·41%
4	Ethyl dibutyroxy mercury acetoacetate	$C_{14}H_{22}O_7Hg_2$	do.	210° C.	Hg 57·46	Hg 57·05%
5	Ethyl di (isopropylacetoxy) mercury acetoacetate	$C_{16}H_{26}O_7Hg_2$	do.	195° C.	Hg 54·68	Hg 54·87%
6	Ethyl dimonochloracetoxy mercury acetoacetate	$C_{10}H_{12}Cl_2O_7Hg_2$	Light yellow to brown	214° C.	Hg 55·82	Hg 56·02%
7	Ethyl ditrichloracetoxy mercury acetoacetate	$C_{10}H_8Cl_6O_7Hg_2$	Light yellow to brownish black	210° C. (swelling)	Hg 46·72	Hg 46·96%

* This compound was prepared by Naik and Patel.[2]

On treatment with bromine in chloroform all the compounds gave the same α, α dibromo ethyl acetoacetate as under :—



It is observed that C-Hg bond is readily ruptured with bromine in all the mercurated products.

Birla Vishvakarma Mahavidyalaya, Vallabh Vidyanagar, (*Via* Anand), and
K. S. PATEL.
Chemistry Department, Sardar Vallabhbhai Vidyapeeth, Vallabh Vidyanagar. (*Via* Anand).
B. N. MANKAD.

1. Naik and Shah, *J. Ind. Chem. Soc.*, 1930, **7**, 655.
2. — and Patel, *Ibid.*, 1932, **9**, 185.
3. — and Shah, *Ibid.*, 1931, **8**, 29.

ESTIMATION OF SELENIUM WITH THIOUREA

YOE AND OVERHOLSER[1] stated that selenous acid gives a red precipitate on treatment with a saturated solution of thiourea. This reaction is utilised in the gravimetric estimation of selenium, which offers a distinct operational advantage over the usual sulphur dioxide precipitation.[2]

Full details of the estimation are given as follows :

About 0·1 gm. of pure selenium is accurately weighed and dissolved in 2 ml. of concentrated nitric acid. The solution is evaporated to dryness. The solid thus obtained is dissolved in about 25 ml. of water to which two or three drops of hydrochloric acid are added. The clear solution of selenous acid is treated with saturated solution of thiourea in excess. A red precipitate of selenium is formed immediately. The precipitate is kept for about two hours at room temperature and heated to boiling with vigorous stirring till the red selenium coagulates to a greyish-black button, and the supernatant liquid becomes clear. Then it is filtered hot through a weighed sintered glass crucible. The element is successively washed first with hot water, then with absolute alcohol and then dried in electric oven at 110° C. for about an hour, cooled in a desiccator and weighed as free element.

The results are tabulated in Table I.

TABLE I

Precipitation of Se by Thiourea

No.	Wt. of Se taken (gm.)	Wt. of Se found (gm.)	Error (gm.)
1	0·0498	0·0500	+ 0·0002
2	0·0641	0·0640	− 0·0001
3	0·1333	0·1332	− 0·0001
4	0·1540	0·1541	+ 0·0001
5	0·1818	0·1816	− 0·0002

This indicates that quantitative estimation is possible for selenium with thiourea. The accuracy of our results was of the same order as that by the sulphur dioxide method.[3]

Dept. of Chem., Karnatak Univ., Dharwar, *June* 19, 1961.
A. SITARAMACHANDRAMURTHY.
M. S. CHANDRASEKHARIAH.

1. John, H. Yoe and Lyle, G. Overholser, *Ind. Eng. Chem., Anal. Ed.*, 1942, **14** (5), 435.
2. Keller, *J.A.C.S.*, 1897, **19**, 771.
3. James, F. Reed, *Anal. Chem.*, 1960, **32** (6), 662.

INFLUENCE OF ADSORBENT ON THE FORMATION OF LIESEGANG RINGS

VARIOUS theories have been proposed from time to time to explain the Liesegang phenomenon. They are based on the results of certain set of periodic reactions. Attempts have been made by some workers to study the influence of foreign substances like sugar,[1] alcohol,[2] powdered glass,[3] on the Liesegang rings. Hughes,[4] Lincoln and Hillyer,[5] Fricke and Sluzelack[6] have postulated from their results that supersaturation does not exist during ring formation of silver chromate in gelatin gel, copper chromate in silicic acid gel, magnesium hydroxide in agar gel. But their conclusions are based upon the analysis of one constitutional ion, and neither is there the analysis of clear spaces after ring formation or involving any calculation.

In the present case investigation is carried out on the influence of adsorbents [*e.g.*, precipitated silica (B.D.H.) and thoroughly washed, dried precipitates of the same substance that forms the periodic structures] on the formation of rhythmic bands of silver chromate in an agar gel medium. The usual procedure of producing Liesegang rings is adopted except that certain quantity of silica and washed, dried precipitate are mixed with suitable quantity of 2% agarsol containing the reagent and allowed to set to gel. These experiments are conducted for seven hours at 8° C. Work on the quantitative aspect has shown close agreement between the values of d obtained on the basis of geometric progression equation and the values actually observed. The influence of adsorbent is expressed in terms

of the spacing coefficient (b) between the two successive rings, and is given by the equation $d = bn^2$, where d is the distance travelled by the diffusion front of each band from the starting point, and n the number of rings formed from the commencement of diffusion. The curve in Fig. 1 shows the analysis of precipitate front

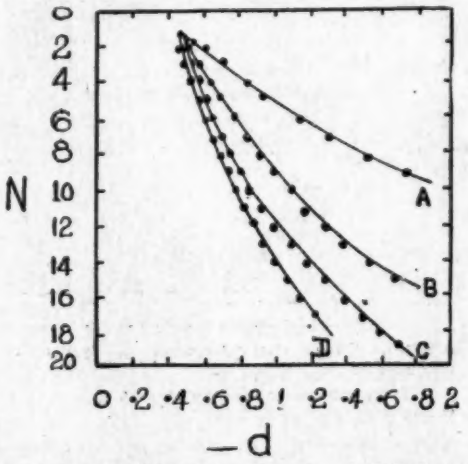


FIG. 1. A—Diffusion in gel only. B—Diffusion in gel containing 0·200 gm. of silica. C—Diffusion in gel containing 0·500 gm. of silica. D—Diffusion in gel containing 0·900 gm. of silica.

after diffusion of 1 N silver nitrate into an agar gel containing N/10 potassium chromate. The steepness of the curve increases with the increase in the concentration of adsorbent. The uniformly distributed particles of the adsorbent act as centres for the condensation of the reactants, and due to their bulk density and porosity influence on the rate of flow of the liquids depending upon the space taken up by the adsorbent in the gel. Table I shows the value of spacing coefficients obtained at different concentrations of the adsorbent.

TABLE I

Sl. No.	Amount of Adsorbent	Spacing Coefficient
1	gel only	0·00514
2	0·200 gm.	0·00113
3	0·500 gm.	0·000407
4	0·900 gm.	0·000393

The diminution in the value of b with the increase in the concentration of the adsorbent is related to the fact that the particles of the adsorbent act as centres for the condensation of the molecules of the reactants with the subsequent relief of supersaturation earlier than under normal condition, resulting lesser spacing between the two successive rings. Bradford and his coworkers[2] have mentioned that the ring formation is the consequence of the adsorption of the solute from the gel. But it is obvious from the present observations of low value of b at higher concentration of the adsorbent, that the supersaturation is more influencing than adsorption in ring formation. Besides, the sparingly soluble substance forms relatively stable and highly supersaturated product. The ultramicroscopic observation has confirmed that the product of reaction is produced in a truly soluble and diffusable form, but not as a colloidal solution.[8] Similar results are obtained using precipitate as adsorbent. Experiments are also conducted on the rhythmicity of Lead iodide and Lead chromate respectively.

The author wishes to express his sincere gratitude to Dr. K. Krishnamurti, for his suggestions and helpful criticism during this work; and to the Director, Geology and Mining Department, for permission to communicate this article for publication.

Chemical Laboratories, B. V. DHARESHWAR.
Mining and Geology Department,
Temple Road, Civil Lines,
Nagpur-1, *March* 21, 1961.

1. Alfred Koenig, *J. Phys. Chem.*, 1920, **24**, 46.
2. A van Hook, *Ibid.*, 1938, **42**, 1191.
3. Don R. Manley and Kurt, Stern, H., *J. Colloid Science*, 1955, **10**, 404.
4. Hughes, *Biochem J.*, 1937, **28**, 1086; *Kolloid Z.*, 1931, **71**, 100; 1955, **72**, 216.
5. Lincoln and Hillyer, *J. Physic. Chem.*, 1936, **40**, 645.
6. Fricke and Suzelack, *Z. Physic. Chemistry*, 1926, **124**, 359.
7. Bradford, J., *Biochem. Z.*, 1916, **10**, 109; 1917, **11**, 14.
8. Dhar and Chatterjee, *J. Phys. Chem.*, 1924, **28**, 41; *Kolloid Z.*, 1922, 31, 15; 1925, **37**, 89.

ESTIMATION OF GALACTURONIC ACID BY PAPER CHROMATOGRAPHY

DURING the course of our investigations on the mucopolysaccharides of blackgram (*Phaseolus radiatus*) it was observed that it contained very small quantities of galacturonic acid which could not be estimated directly by the colorimetric method of Dische.[1,2] The high viscosity of the polysaccharide solution was an additional difficulty. A chromatographic method is described here which can be used for estimating small quantities of galacturonic acid in polysaccharides of similar materials.

In initial experiments to estimate galacturonic acid by paper chromatography very high paper blanks were obtained. Washing with water or 2 N hydrochloric acid followed by water washings were found to reduce the paper blanks from an initial value of 50 to 6. Washed Whatman No. 1 papers were, therefore, used in further work. The following is a brief description of the method used for estimation.

The hydrolysate of the polysaccharide was spotted on the treated paper (23 × 20 cm.) and chromatograms were developed by the ascending technique using butanol : acetic acid : water (4 : 1 : 5) and phenol : water (2 : 1) systems.[3,4] The phenol system contained a small amount of ammonia and sodium cyanide. Good separations were achieved by allowing chromatograms to overrun for 24 hours with the first solvent and using filter-paper circles to assist the solvent flow.[5] The phenol run was usually for 6-7 hours. After allowing the paper to dry overnight, it was sprayed with benzidine trichloracetic acid.[6] The acid could also be located under ultra-violet light. The spots were cut out, eluted by three successive extractions with 5 ml. water for half hour and after centrifuging, the combined eluates were evaporated to dryness over a water-bath. The residue was taken up with 1 ml. water and the galacturonic acid estimated colorimetrically according to Dische.[2] Standard galacturonic acid at various dilutions was also spotted and estimated as above after chromatography.

Glucuronic acid by itself did not develop any colour under these conditions. When superimposed on the galacturonic acid it did not also enhance the colour readings (Fig. 1). The standard curve relating the colour readings to the galacturonic acid concentration followed a straight line course. Recovery of acid added to the polysaccharide hydrolysate was also good (94–98%) (Table I). 20–50 γ of galacturonic acid in the polysaccharide could be estimated by the method.

TABLE I

% Recovery of added galacturonic acid

Hydrolysate in ml.	Stanard galacturonic acid added in μg.	Optical density × 500 at 540 mμ	Recovery %
0·08	..	35	..
..	80	84	..
0·08	80	117	97·5
..	160	170	..
0·08	160	192	93·75

The polysaccharide was hydrolysed by refluxing 20 mg. of the substance with 2 ml. of 2 N HCl in a boiling water-bath for 3 hours. The values are averages of four replicates and are corrected for the blanks.

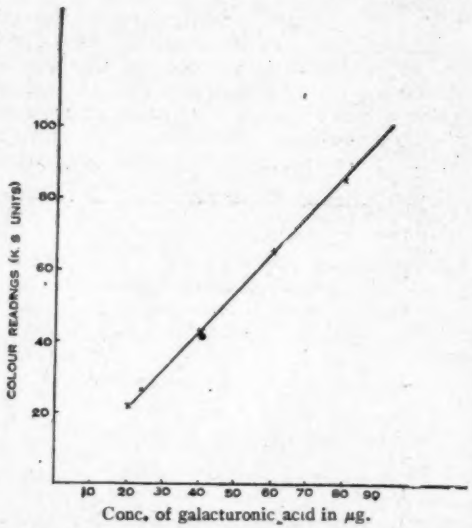


FIG. 1. Estimation of galacturonic acid by the Dische method after chromatography.

● Represents colour reading when 40 γ glucuronic acid was superimposed on the galacturonic acid.

The authors' thanks are due to Dr. V. Subrahmanyan and Dr. M. Srinivasan for their kind interest in the work.

C.F.T.R.I., Mysore, *March* 1961. S. B. KADKOL. H. S. R. DESIKACHAR.

1. Dische, Z., *Arch. Biochem.*, 1948, **16**, 409.
2. —, *J. Biol. Chem.*, 1950, **183**, 489.
3. Partridge, S. M., *Biochem. J.*, 1948, **42**, 238.
4. Radhakrishnamurthy, R. and Sarma, P. S., *Curr. Sci.*, 1954, **23**, 266.
5. — and —, *J. Sci. Industr. Res.* (*India*), 1952, **11 B**, 279.
6. Bacon, J. S. D. and Edleman, J., *Biochem. J.*, 1951, **48**, 114.

OCCURRENCE OF AMINO-ACIDS AND ALLIIN IN THE INDIAN *ALLIUMS* (GARLICS)

ALLIUM species or garlics are commonly used as an article of food and condiment. Preparations of garlic have been used in medicine for a wide variety of ailments.[1,2] In recent years a crystalline principle alliin, a precursor of the antibacterial principle allicin, has been isolated[3-4] from *A. ursinum* and *A. sativum* and pharmaceutical products containing allicin are available in the market. A detailed work on the amino-acid composition of onion and garlic has been reported previously by Parthasarathy and Sastry.[5] However, knowledge about the amino-acids in the other less-known Indian Alliums

is very meagre. Except for the work of Rao *et al.*,[6] no work regarding occurrence of alliin in other Indian Alliums is reported so far. The purpose of the present study was to determine the amino-acid composition of Indian Alliums and also to screen these species for the presence of alliin.

Allium sativum and *A. cepa* were procured from the local market, *A. ampeloprasum* from Mussoorie, red variety bulbs and bulbils of *A. sativum* and a triploid *Allium species*[7] available under the name of 'Pran' from Kashmir, *A. rubellum* from Pathankot and one unidentified species from Lloyd Botanical Garden, Darjeeling. For amino-acid determination, 5 g. of the fresh material was homogenized with 10 ml. of 75% alcohol and 25 λ of the clear filtrate of each of the variety was subjected to paper chromatography using butanol : acetic acid : water (4 : 1 : 5) and phenol : isopropanol : water (14 : 1 : 5) as solvent systems. The amino-acids were identified by their Rf. values in the above two solvents, by their colour with ninhydrin and alloxan[8] and finally by comparing their movements with those of reference amino-acids on paper chromatograms. A rough idea about the relative amount of each amino-acid was obtained by observing the intensity and size of the coloured spots on chromatograms. The results are shown in Table I.

yellowish-brown spot with ninhydrin (Rf. 0·27 in butanol, acetic acid, water and 0·68 in phenol, isopropanol, water), and as little as 0·006 γ of alliin could be detected on paper chromatograms. However, no spot of alliin could be discovered in the chromatograms originally run for detection of amino-acids. When whole bulbs were stabilized by immersion in boiling water for 5 minutes, prior to extraction and chromatography, in order to destroy the enzyme alliinase,[9] alliin could be detected in *A. sativum* (red and white varieties), *A. ampeloprasum* and *A. species* (pran). It was totally absent in all other varieties investigated including the bulbils of *A. sativum*.

A method for semi-quantitative determination of alliin was developed in which use was made of the observation that the size of spot of alliin on chromatograms was generally proportional to the amount of alliin present. Similarly if a number of spots were applied, each representing the same amount of alliin, the size of spots produced after development of chromatogram was consistently identical.

5 g. of stabilized bulb was homogenised in a waring blendor with 10 ml. of 70% ethanol, filtered, and volume of the filtrate was again adjusted to 10 ml. by addition of 70% ethanol. With a micropipette 25 λ of this extract was applied on a sheet of Whatman No. 1 chromatographic paper. On the starting line of the same

TABLE I

Amino-acid composition of various species of Allium

Amino-acid	*Species*							
	A. ampeloprasum	*A. sativum* local white variety	*A. sativum* (red variety)	*A. rubellum*	*A. species* (Pran)	*A. sativum* (Bulbils)	*A. cepa*	Unidentified *A. species*
Alanine	++	+++	+++	+++	++	+++	++	++
Arginine	+++	+++	+++	Absent	++	+++	+	Absent
Aspartic acid	++	+	++	++	Tr.	Tr.	Tr.	Tr.
Asparagine	+	++	+	++	+	+	Tr.	Absent
Histidine	+	Tr.	+	Tr.	Absent	+	+	Tr.
Leucine	+	++	++	+++	+	Tr.	++	+
Methionine	+++	+++	+++	+	+	++	+	Absent
Phenyl-alanine	++	++	+	Absent	Absent	Tr.	Tr.	Absent
Proline	Tr.	+	+	Absent	Absent	Tr.	+	Absent
Serine	++	+	++	+++	+	+	+	+
Threonine	++	Tr.	+	++	Absent	++	+	Tr.
Tryptophan	+++	++	+++	Tr.	Tr.	Absent	Tr.	+
Valine	++	++	++	+++	Absent	Absent	Tr.	Absent
Unidentified amino-acid	..	..	..	..	2	2	1	3

Tr. = traces; +, ++, +++, indicating relative amounts of amino-acids.

According to Stoll[2] alliin gives a positive colour reaction with ninhydrin and alloxan. It was found by the authors that alliin gives a

sheet of paper 5 more spots representing 10, 20, 30, 40, 50 λ of an alliin solution (5 mg./c.c.) were applied, representing 0·05, 0·1, 0·15, 0·2

and 0·25 γ of pure alliin. After the development of the chromatogram the size of alliin spot given by the garlic extract was compared with the size of spot produced by the known graded quantities of pure alliin. This comparison gives a rough idea of amount of alliin present in 25 λ of the garlic extract and the percentage of alliin could be calculated from the results thus obtained. *A sativum* (Kashmir red), *A. sativum* (local white), *A. ampeloprasum* and *A. species* (pran) contained approximately 1·0%, 0·8%, 0·4% and traces of alliin respectively.

Thus, it has been shown that red variety of *A. sativum* is the richest source of alliin and that alliin is also present in significant amount in the hitherto uninvestigated *A. ampeloprasum*.

Our thanks are due to Dr. T. N. Khoshoo for help in providing authentic samples and to the Director, Research, Sandoz Ltd., Basle, Switzerland, for the supply of alliin sample.

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Chandigarh-3, *May* 29, 1961.

1. *Wealth of India*, Counc. Sci. Indust. Res., New Delhi, 1948, **1**, 59.
2. Stoll, A., *Indian Pharmacist*, 1953, **8**, 349.
3. — and Seebeck, E., *Experientia*, 1947, **3**, 114.
4. Cavallito, C. and Bailey, J., *J. Amer. Chem. Soc.*, 1944, **66**, 1950.
5. Parthasarathy, K. and Sastry, C., *Indian Jour. Pharm.*, 1959, **21**, 283.
6. Rao, R., *et al.*, *Jour. Sci. Indust. Res.*, 1946, **5**, 31.
7. Khoshoo, T. N., Atal, C. K. and Sharma, V., *Panjab Univ. Res. Bull.*, 1960, **11**, 37.
8. Saifer, A. and Oreskes, I., *Annal. Chem.*, 1956, **28**, 501.
9. Pruthi, J., Singh, L. and Lal, G., *Curr. Sci.*, 1959, **28**, 403.

HARDBOARDS FROM *LANTANA*

At the request of the Maharashtra State Forest Department the suitability of *Lantana* for hardboard manufacture was investigated. The material was supplied by the Range Forest Officer, Chikalda Range, Amravati Circle. According to the Conservator of Forests, Amravati Circle, about 25,000 tons/year of the material are available.

In the earlier experiments the material in the form of chips was cooked at atmospheric pressure with alkali and defibrated in a Condux mill. As the material is hard the results were not very satisfactory. So in later experiments the material was subjected to a prehydrolysis with water alone, defibrated and again cooked with mild alkali. The pulp was subjected to the usual procedure and pressed at 200 lb./sq. inch at 160° C. for 30 minutes (3/16" thickness of the board). The cooking conditions and results of strength and other tests are given in Table I.

As can be seen from Table I from strength point of view satisfactory boards have been obtained under all conditions. With prehydrolysis the results are very good. However,

TABLE I

Properties of hardboards from Lantana *twigs*

No.	Alkali and concentration	Solid : liquid ratio	Time of cooking hrs.	Pulp recovery %	Ordinary board: Density g./cm.³	M.C. %	Modulus of rupture Kg./cm.²	Moist. % absorption in 24 hrs.	Tempered board: Treatment	M.C. %	Modulus of rupture Kg./cm.²	Moist. % absorption in 24 hrs.
1	Lime 1·5% ..	1 : 4	3	62	1·02	8·9	(271)	174·8	(*b*)	7·9	378	74·8
									(*c*)	..	341	65·2
2	Lime 2·5% ..	1 : 5	3	61	1·01	15·3	(232)	142	(*a*)	7·9	144	100
									(*b*)	7·5	238	81
									(*c*)	5·8	258	75
3	NaOH 0·5% ..	1 : 5	2½	63	1·01	10·4	(254)	162	(*a*)	12·2	152	97
									(*b*)	8·8	262	101
									(*c*)	7·8	294	60
4	NaOH 0·75% ..	1 : 5	2½	62	1·04	11·3	(207)	150	(*b*)	8·5	277	79
									(*c*)	5·8	319	70
5	NaOH 0·75% .. (after preboiling with water for one hr.)	1 : 5	1½	60	1·05	5·2	383	152	(*b*)	7·5	460	71
									(*c*)	6·4	468	59

Note.—Treatments: (*a*) Added 3% rosin to pulp; (*b*) Tempered at 180°C. for 2 hours; (*c*) Tempered at 180° C. with C.N.S.L. for 2 hours.

the moisture absorption is rather high. This has to be improved. It will be useful to examine whether this material can be mixed with hard woods for board manufacture.

Forest Research Inst., Dehra Dun, May 22, 1961.

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DISCOVERY OF OSTRACODA AND SMALLER FORAMINIFERA FROM THE UPPER CRETACEOUS BAGH BEDS, M.P.

A RICH and varied assemblage of Ostracoda and Microforaminifera has recently been discovered by the writer from the Deola Marl stage of the Bagh formations of M.P. Although larger invertebrate fossils were recorded from these beds as early as 1857, little attention seems to have been paid to microfossils. The only paper within the author's knowledge dealing with foraminifera from these beds is by Singh (1950).

The writer has identified 22 species of ostracodes from the Deola Marls. These include 10 new species. A check-list is given below:

Paracypris sahnii n.sp., *P. jonesi* (Bonnema), *P. monmouthensis* (Schmidt), *P. gracilis* (Bosquet), *P. limburgensis* (Veen), *Bairdia misrai* n.sp., *B. obliqua* (Alexander), *Bythocypris chiplonkeri* n.sp., *B. goodlandensis* (Alexander), *Macrocypris?baghensis* n.sp., *?Macrocypris graysonensis* (Alexander), *Cythereis* sp. aff., *C. krummensis* (Alexander), *Cytherura thuatiensis* n.sp., *Haplocythereidea?punctura* (Schmidt), *Monoceratina tewarii* n.sp., *Monoceratina* sp. indet., *?Paracypridea obovata* (Swain), *Cytherella contracta* (Veen), *Cytherelloidea indica* n.sp., *C. subgranulosa* n.sp., *C. raoi* n.sp., *Brachycythere bhatiai* n.sp.

A brief diagnosis of the new species described is given below:

Paracypris sahnii JAIN, N.SP.

Carapace compressed, elongate in side view; dorsal margin angulate anteriorly and posteriorly; the middle portion between the two angulations longest and straight; anterior margin obliquely rounded, posterior acuminate; greatest height anterior; left vale slightly larger and overlapping ventrally; surface smooth.

Bairdia misrai JAIN, N.SP.

Carapace compressed, elongate in side view, sub-triangular in outline; dorsal margin arched, ventral margin convex; anterior margin narrowly rounded, posterior produced into a sub-acute beak; greatest height just behind the middle; left valve larger and slightly overlapping.

Bythocypris chiplonkeri JAIN, N.SP.

Carapace elongate, reniform, highly inflated when viewed dorsally; dorsal margin evenly arched, ventral straight; anterior margin broadly and posterior narrowly rounded; greatest height and width lies in the middle; width slightly greater than the height; surface closely pitted.

Macrocypris? baghensis JAIN, N.SP.

Carapace elongate, smooth, highest at the anterior angulation just in front of the middle, from where the dorsal margin tends to become straight; ventral margin very nearly straight; posterior margin produced and pointed in the middle; the hinge of the right valve consists of a groove which starts just below the anterior angulation and runs up to nearly half the length of the valve, followed by a bar; the other elements of the hinge—two serrate ridges and a posterior groove—are indistinct.

Brachycythere bhatiai JAIN, N.SP.

Carapace elongate, highly inflated ventrally, sub-triangular in side view; dorsum arched, venter straight; greatest height at the anterior angulation just in front of the middle; anterior margin broadly rounded, posterior pointed below; when viewed dorsally the ends are compressed and pointed; hinge hemiamphidont.

Cytherura thuatiensis JAIN, N.SP.

Carapace sub-rectangular in outline, elongate, smooth; dorsal margin convex, ventral margin keeled, straight and with a prominent ridge; anterior side broadly rounded, posterior drawn out dorsally into a caudal process; anterior margin rounded as seen in the dorsal view, posterior compressed and pointed; greatest height anterior.

Monoceratina tewarii JAIN, N.SP.

Carapace elongate, sub-quadrate; anterior margin broadly rounded and rimmed; the ventral ridge with a large posterior spine and three subsidiary nodes, the posterior being the weakest; two more nodes are present on the anterior and posterior ridges.

Cytherelloidea indica JAIN, N.SP.

In both the valves a ridge starts from the antero-dorsal margin which runs continuously throughout the ventral and posterior margins, then bends below the antero-dorsal margin just below its commencement, and then forms a loop.

Cytherelloidea subgranulosa JAIN, N.SP.

The carapace with a discontinuous rim on the anterior and posterior margins; two nodes are present on the posterior shoulder; a discontinuous ridge starts from the upper node below

the dorsal rim, another ridge is present just above the ventral rim; surface with a number of small tubercles which are largely confined to the middle part of the carapace.

Cytherelloidea raoi JAIN, N.SP.

Carapace with a marginal rim on the dorsal and posterior margins; a rib starts from the postero-dorsal tubercle just below the anterior rim, and runs for the greater length of the carapace, and curves round the muscle pit.

Besides the Ostracodes the writer has identified the following foraminiferal genera: *Quinqueloculina, Triloculina, Discorbis, Cibicides, Neobulimina, Lenticulina, Planularia, Frondicularia, Nodosaria, Marginulina, Palmula, Globigerina* and *Globorotalia*.

Ophuroid ossicles, echinoid spines and dwarf and juvenile forms of gastropods, lamellibranchs and brachiopods are also very common in the Bagh material.

The author is deeply indebted to Prof. M. R. Sahni of Panjab University for the kind perusal of the manuscript and to Dr. S. B. Bhatia of Panjab University for the help received during the course of the present work.

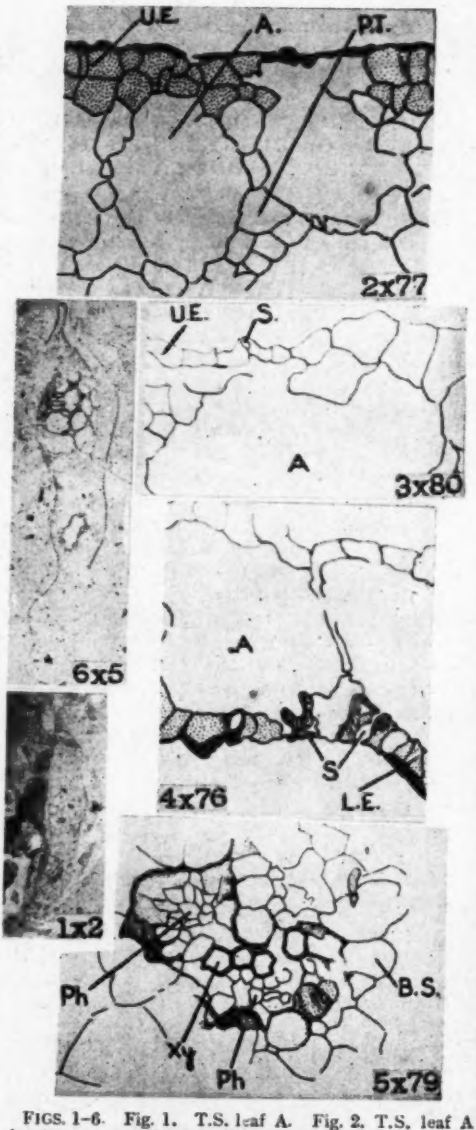
Department of Geology, S. P. JAIN.
Panjab University,
Chandigarh-3, *August* 3, 1961.

1. Carter, H. J., *Jour Bom. Br. Roy. As. Soc.*, 1857, **5**, 614.
2. Howe, H. V. and Laurencich, Laura, *An Introduction to the Study of the Cretaceous Ostracoda*, Louisiana State University Press, 1958.
3. Singh, S. N., *Curr. Sci.*, 1950, **19**, 174.

PETRIFIED MONOCOTYLEDONOUS LEAVES FROM THE TERTIARY OF MADHYA PRADESH

THE two petrified monocotyledonous leaves described here were collected by the author in the year 1953 from the Deccan Intertrappean Beds near Mohgaon-kalan village of Chhindwara district. The geological age of these beds has already been determined as tertiary (Eocene).

The leaves are preserved in the reddish-brown and brownish black cherts, which occur abundantly in these beds. For studying their anatomy, several peel sections were taken with the help of the author's improved technique.[1] Such leaves have not so far been reported from these beds, the known forms being dicotyledonous leaves in the form of impressions and petrifactions[4,5] from the different localities of Chhindwara district. These have been obtained from the different cherts and may be called leaf A and leaf B for the sake of convenience. Both are aquatic in nature and probably belong to the same plant.



FIGS. 1–6. Fig. 1. T.S. leaf A. Fig. 2. T.S. leaf A showing upper epidermis (U.E), air-chambers (A) and partition wall (P.T.). Fig. 3. T.S. leaf A showing upper ep.dermis (V.E), vestigial stoma (S) and air-chambers (A). Fig. 4. T.S. leaf A showing lower epidermis (L.E), stomata (S) and air-chambers (A). Fig. 5. A single V.B. of leaf A showing bundle sheath (B.S.), xylem (XY) and phloem (Ph). Fig. 6. T.S. leaf B.

Leaf A.—This is more or less completely preserved, preservation being very good. However, its two margins have not come in the peel sections. It measures 8× 3·3 mm. in cross-section. The general appearance is spongy. The surfaces of the leaf are slightly wavy. The epidermis is a thin naked layer; cuticle is lacking (Fig. 1).

The upper epidermis is double layered (Fig. 2). At places vestigeal stomata-like structures are visible (Fig. 3).

Numerous air-chambers of varying sizes are present below the epidermal layers. These are separated from each other by 1-celled partition walls of irregular parenchymatous cells.

The lower epidermal cells are smaller in size than the cells of the upper epidermis but are all pentagonal in shape. Air-chambers of the ventral surface probably open by means of stomatal openings (Fig. 4).

The vascular bundles are many and scattered throughout the body of the leaf. Nearly ten vascular bundles of monocotyledonous type have, however, been traced in the peel section. The bundles are enclosed in a parenchymatous bundle sheath (Fig. 5). The bundle sheath resembles the endodermis but is weakly developed.[2] It was not possible to find chloroplast and casparian strips in the cells of the sheath. These cells are in close association with the conducting elements of the vascular bundle on their inner faces and with the spongy mesophyll and epidermis on the outer face. Morphologically these cells are a part of mesophyll.

There is a considerable reduction in the vascular bundles which is a remarkable feature of aquatic angiosperms. The xylem elements are surrounded by phloem cells. It is worthwhile mentioning here that in some of the smaller bundles, the xylem vessels are completely absent. The phloem cells are many as compared with the xylem vessels of the vascular bundles.

Leaf B.—The partial preservation of this leaf does not furnish enough details for studying its anatomy. It measures 11 × 2 mm. in cross-section (Fig. 6). It resembles the leaf A in having air-chambers and in being spongy in nature. The surfaces are wavy and the presence of considerable amount of ærenchyma tissue provides a good amount of buoyancy to the leaf. The air-cavities are prominent and scattered internally throughout the leaf. The epidermal cells are small, walls of the air-cavities are multi-layered and parenchymatous.

I take this opportunity for expressing my sincere thanks to Dr. M. R. Sahni, of the Punjab University, for his valuable suggestions and for going through the manuscript.

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Jaunpur (U.P.).

1. Dwivedi, J. N., *Science and Culture*, 1959, **24**, 481.
2. Eames, A. J. and Mac Daniels, L. M., *An Introduction to Plant Anatomy*, 1947, 328.
3. Sahni, B., *Curr. Sci.*, 1934, **3**, 134.
4. Shukla, V. B., "Palæbotany in India–VII," Reprinted from *J. Indian bot. Soc.*, 1950, **20** (i), 29.
5. Trivedi, T. (Mrs.), *J. Palæontological Soc.*, 1956, **1** (i), 186.

A NEW SPECIES OF *PEYRONELLAEA* GOID

GOIDANICH[1] created this genus in 1946 to accommodate some members of Sphæropsidales which possessed ostiolate pycnidia like those of *Phoma* or *Phyllosticta* but their chlamydospores (Hypnocysts) resembled the dictyospores found in hyphal dematiaceæ such as *Alternaria* or *Coniothecium*, etc.

In March 1958 the authors observed a serious leafspot disease on the plants of *Eriobotryæ japonica* at Naini Agricultural Institute, Allahabad. The infection was mostly either marginal or from the tips and developed brown lesions on the leaf-blade. Occasionally few scattered spots were also observed. Isolations from most of the diseased regions yielded an *Alternaria*-like fungus in culture. About a month later few ostiolate pycnidia were also formed in those cultures. On account of this peculiarity the organism was sent to Commonwealth Mycological Institute, Kew, where it was identified to be a species of *Peyronellæa*. Detailed investigations established that cultures derived from single pycnidiospores produced dark brown pycnidia as well as multiseptate muriform chlamydospores, while the culture plants seeded with chlamydospores alone developed pycnidia also in 6-7 days. The development of pycnidia was considerably increased if maltose was one of the ingredients of the culture medium. A spray with spore suspension produced typical symptoms on the host in 4-6 days but the chlamydospores required about 10 days for causing the infection.

Morphological characters of this species were not in complete agreement with any of those Sphæropsidales[2] which have been transferred to this genus or with any other species referable to genus *Peyronellæa*.[3,4] Due to obvious differences in its habitat as well as in the size of chlamydospores, pycnidia and pycnidiopores, this species is described as *Peyronellæa*

nainiensis, sp. nov. having the following characters:

FIG. 1. *Peyronellæa nainiensis*. A. Chlamydospores; B. A portion of pycnidium; C. Spores.

Peyronellæa nainiensis, sp. nov.—Chlamydospores abundant, intercalary, usually in chains, variable in shape and size, light-brown, resemble the conidia of *Alternaria tenuis*. Number of septa varies from 1-6, usually three transverse septa and one or two longitudinal septa, 13–46·8 × 9·1–16·9 μ. Pycnidia dark-brown or black, generally spherical or slightly oval, 80–135 × 73–121 μ prominantly ostiolate, conidia numerous, hyaline, ellipsoidal 3·2–5·3 × 1·9–2·6 μ.

Latin translation

Peyronellæa nainiensis spec. nov.—Chlamydosporæ abundantes, intercalares, vulgo catenatæ, formæ et magnitudinis variabilis, pallide brunneæ, similes conidiis *Alternariæ tenuis*. Septa numero variabili, 1–6, vulgo 3 transversa, unum vel duo longitudinalia, 13–46·8 × 9·1–16·9 μ. Pycnidia fusce brunnea vel nigra, vulgo sphærica vel paulum ovalida, 80–135 × 72–121 μ, eminenter ostiolata. Conidia plurima, hyalina et ellipsoidea, 3·2–5·3 × 1·9–2·6 μ. In foliis *Eriobotryæ japonicæ*.

The authors are grateful to Dr. J. C. F. Hopkins, Director, C.M.I., Kew, for his assistance in identification of the fungus and to Prof. H. Santapau, for the Latin translation.

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1. Goidanich, G., *R.C. Acaad. Lincii.*, 1946, **3**, 449.
2. —, *Ibid.*, 1946, **5**, 654.
3. Lacoste, L., *C R. Acad. Sci.*, Paris, 1955, **13**, 818.
4. Togliani, F., *Ann. Sper. Agr.*, N.S., 1952, **6**, 81.

RUMINATE ENDOSPERM IN THE CANELLACEAE

THE phenomenon of endosperm rumination has been reported in about 29 families of dicotyledons, one in monocotyledons and one in gymnosperms (Periasamy, 1959). The occurrence of this peculiar morphological character is proving to be of immense value in problems concerning taxonomy and phylogeny as has been pointed out by Corner (1949, 1951).

During the course of a comparative morphological study of the Canellaceæ, the author had the opportunity to examine the seeds of several genera of the family. The endemic genus *Cinamosma* from Madagascar with its two species, *C. madagascariensis* (Herb. No. Pret. 2712/43. 58 and 2713/43. 58) and *C. macrocarpa* (Herb. No. 5088/Pret. 2716/43. 58, Type specimen) obtained through the courtesy of the Director, National Museum, Paris, showed the presence of rumination. The rumination processes are rather mildly developed in *C. macrocarpa* and more pronouncedly in *C. madagascariensis* (Figs. 1, 2). In the

FIGS. 1–3. Fig. 1. *Cinnamosma macrocarpa*. Part of the seedcoat showing ruminate processes, × 160. Fig. 2. *Cinnamosma madagascariensis*. Longisection of seed showing ruminate seedcoat, × 52. Fig. 3. *Cinnamosma madagascariensis*. A rumination process enlarged from Fig. 2, × 100.

absence of complete developmental stages it is difficult to ascertain the individual share of the outer and inner integuments in the building of the rumination processes, although a careful examination of the available stages suggests that at least one or two layers of the inner integument line the interior of the processes. The outer integument which consists of several cell layers with numerous oil cells constitutes the major bulk of the rumination process (Fig. 3). The rumination process is devoid of any vasculature. This may prove to be of diagnostic value in the light of the vascularized rumination processes of *Myristica fragrans*, *Actinophlæus ambiguus*, *Areca catechu*, *Caryota furfurcata*, etc.

It may also be noted here that the seeds of *Cinnamosma* differ from those of other genera (*Canella*, *Cinnamodendron*, *Warburgia*, *Capsicodendron* and *Pleodendron*) not only by the possession of ruminate processes but also by the absence of a sclerosed outer epidermal layer of the outer integument. Thus the ruminating seedcoat of *Cinnamosma* is wholly parenchymatous. Although Netolitzky (1926) has figured such a structural feature in the seedcoat of *Cinnamosma* he has not reported the occurrence of rumination.

I am deeply indebted to Prof. B. G. L. Swamy for kind encouragement and criticism.

Department of Botany, Presidency College. Madras-5, *July* 21, 1961.

N. PARAMESWARAN.

1. Corner, E. J. H., *New Phytol.*, 1949, **48**, 332.
2. —, *Phytomorphology*, 1951, **1**, 117.
3. Netolitzky, F., *Anatomie der Angiospermensamen*, Berlin, 1926.
4. Periasamy, K., *Ph.D. Thesis*, Madras Univ., 1959.

NEW RECORDS OF MICROFUNGI FROM USAR-SOILS OF INDIA

DURING the study of soil "microflora" of Usar (alkaline)-soils of Uttar Pradesh, India, a large number of microfungi and bacteria have been isolated. For the purpose of this study Usar-soils, with varying pH between 7·1 and 11·5 were randomly selected from Lucknow, its neighbourhood and few other districts of U.P.

So far about 125 species of fungi have been isolated from nearly 600 soil samples that have been investigated during the period September 1957 to December 1960. The relative percentage of species of each class of fungi occurring in these soils is as follows:

Phycomycetes 20%, Ascomycetes 16%, Basidiomycetes 0% (nil), Deuteromycetes (Fungi Imperfecti) 64%.

A scrutiny of the available literature showed the following 17 forms to be either new records from soils or from Indian soils and the list is given in Table I, along with the pH-range of the soils, from which they were isolated.

TABLE I

Sl. No.	Fungi	pH–range
1	**Absidia repens* van Tiegh. ..	7·1–10·0
2	**Circinella umbellata* van Tiegh. & Le Mon.	7·2– 8·2
3	**Mucor bacilliformis* Hess. ..	7·1– 8·5
4	**Mucor geneventis* Lend. ..	7·1 - 8·5
5	**Zygorhynchus heterogamous* Vuill. ..	7·1– 8·2
6	**Blakeslea trispora* Thax. ..	7·1– 8·2
7	**Arachniotus citrinus* Massee & Sal. ..	7·1– 7·3
8	**Chætomium eristatum* Ames. ..	7·1–10·5
9	†*Ascotricha guamensis* Ames. ..	7·1– 9·0
10	†*Gelasinospora* sp. nov. ..	7·1– 9·5
11	†*Triptercspora* sp. nov. ..	7·2–10·2
12	**Sparonæma spinella* Kalch. ..	8·2–10·5
13	**Fusidium terricola* Miller *et al.* ..	8·0– 8·2
14	**Penicillium aurantiacum* Miller *et al.*	7·1– 8·0
15	**Spicaria violacea* Abbott. ..	7·1– 9·2
16	**Papularia spharosperma* (Pers.) vön. Hon.	7·1– 8·5
17	†*Graphium* sp.	7·1– 8·5

* First report from Indian soils;
† First report from soils.

In addition to the forms described above several other species of fungi have been isolated from these soils. These, although they have been reported earlier, are of rare occurrence, and include *Choanephora conjuncta* Couch; *Circinella muscæ* (Sor.) Berl. and de Toni; *Thielavia setosa* Dade; *Pyrenochæta decipiens* March.; *Aspergillus carneus* (v. Tiegh.) Bloch.; *Nigrospora sphærica* (Sacc.) Mason; *Heterosporium allii* Ellis and Mart.; *Colletotrichum falcatum* Went; *Colletotrichum dematium* (Pers. Ex. Fr.) Grove and *Epicoccum nigrum* Link.

The authors wish to express their gratitude to Prof. Roy F. Cain for his valuable suggestions, and to the Director, Commonwealth Mycological Institute, Kew (England), for confirming the identifications of few of the forms.

Microbiology Laboratory, Botany Department, Lucknow University, Lucknow, January 28, 1961.

J. N. RAI.
K. G. MUKERJI.

A LEAF DISTORTING VIRUS DISEASE OF *JATROPHA CURCAS* LINN.

Jatropha curcas Linn. is grown in this region as a field barrier by the cultivators. Serious disease symptoms were observed on a large number of *Jatropha curcas* plants in various localities of Indore during the rainy season of

1957. The symptoms consisted of marked reduction in the leaf size, rolling of leaf margins upwards and prominent puckering of the leaf surface. Chlorotic areas of irregular shape were present on the lamina near the margin and in between the main veins (Fig. 1). There were minute but distinct enations along the veins on the under-surface of many leaves.

FIG. 1

TRANSMISSION TESTS

Plants raised from seeds collected from diseased plants during the previous season remained healthy showing thereby that the disease is not transmissible through seed.

Two to three weeks old healthy and vigorously growing plants raised under insect proof conditions from seeds were inoculated with the juice of diseased leaves in the usual way using carborundum powder as an abrasive. None of the inoculated plants developed disease symptoms indicating that the disease is not transmissible by sap inoculation.

Shoots from infected *Jatropha curcas* plants were cleft grafted on healthy *Jatropha curcas* plants. The grafts were covered individually by muslin bags which were kept wet to provide humid conditions necessary for the organic union between the stock and the scion. This method worked well and when new shoots developed on the stocks they developed typical symptoms of the disease (Fig. 2) showing that the disease is transmissible by grafting, thus confirming its viral nature.

As certain plant viruses have been found transmissible to healthy plants through dodder (*Cuscuta sp.*)[1,2] and as the virus under report is not transmissible by sap inoculation, attempts were made to transmit the disease by the agency of dodder, but without success.

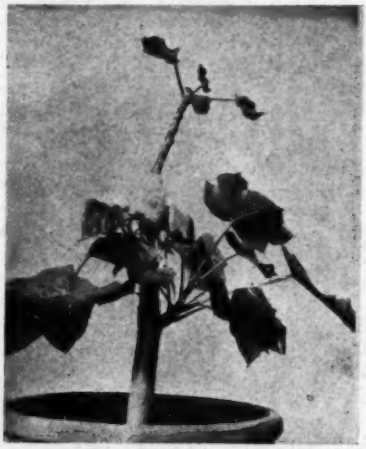


FIG. 2

Transmission tests with the tobacco leaf curl virus vector, the white fly (*Bemisia tabaci* Gen.)[3] also gave negative results.

HOST RANGE TESTS

The disease could not be transmitted to any other plant except *Jatropha curcas*. Attempts made to transmit it by grafting to *Nicotiana tabacum* L., *Lycopersicum esculentum* Mill., *Solanum melongena* L. and *Datura stramonium* L. were not successful.

The symptoms of the disease described resemble to some extent those produced by the tobacco leaf curl virus on certain of its hosts,[4] but whereas the latter is transmitted by white flies the virus causing disease in *Jatropha curcas* is not transmissible by these insects. Moreover, chlorosis which is so prominent in the case of the disease on *Jatropha* is not common on plants attacked by the tobacco leaf curl virus. The virus causing the disease in *Jatropha curcas* should, therefore, be considered as distinct.

I am grateful to Dr. W. V. Bhagwat, Principal, for providing facilities for work.

Department of Botany, Holkar College, Indore, *December* 12, 1960.

R. P. GARGA.

1. Johnson, F., *Phytopathology*, 1941, **31**, 649.
2. Kunkel, L. O., *Ibid.*, 1952, **42**, 27.
3. Pruthi, H. S. and Samuel, C. K., *Indian J. Agric. Sci.*, 1939, **9**, 223.
4. Smith, K. M., *A Text Book of Plant Virus Diseases*, Second Edition, J. and A. Churchill Ltd., London 1957.

A POLYHAPLOID PLANT OF *SORGHUM HALEPENSE* (L.) PERS.

THOUGH the production of plant species by means of chromosome doubling is now recognized as a common phenomenon, the reverse process of reduction in chromosome number, such as the occurrence of haploids from diploids by parthenogenesis, is still a rare and uncontrolled phenomenon. The significance of polyhaploids as tools for experimental research in cytogenetics and genetics as well as for breeding has been amply demonstrated in other crops such as corn[1] and cotton.[2] The origin and nature of ploidy in *S. halepense* ($2n = 40$) is still a matter of considerable controversy. Some workers[3] are of the opinion that it could be an autotetraploid and others[4-6] believe it to be an allotetraploid. While others[7] consider it to be a segmental alloploid or that it could be a quantitative polyploid.[8]

The present paper reports the occurrence of a polyhaploid plant in the F_1 population of a cross between *S. halepense* (Sub-section *Halepensia*) $2n = 40$ ♀ and *S. verticilliflorum* (Sub-section *Arundinacea*) $2n = 20$ ♀. About 20 florets were emasculated in *S. halepense* and pollinated with the pollen of *S. verticilliflorum* under controlled conditions. The four seeds obtained from this cross were sown in pots in the green-house, along with the parents but only one germinated. Even this single plant did not exhibit any of the characters of the male parent but resembled the female parent in almost all its characters. It was first suspected that it may be the result of accidental selfing. However, cytological examination showed that this plant contained only 20 chromosomes in its somatic cells suggesting that it might, presumably, have arisen by haploid parthenogenesis. Since species with $n = 10$ are known in this genus, this plant with $2n = 20$ must be considered to be polyhaploid.

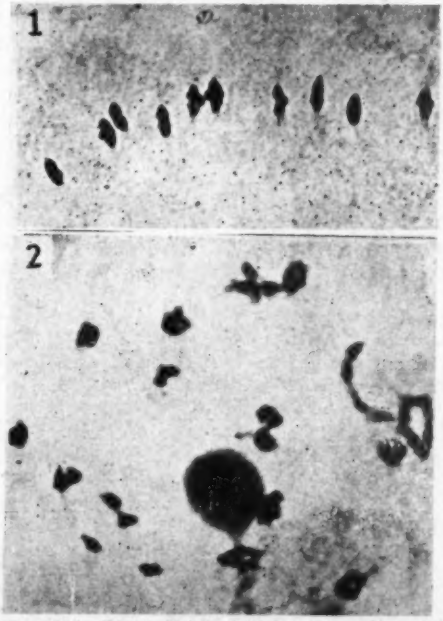
During the early stages of growth this plant showed slower growth than the tetraploid *S. halepense*. At maturity, however, the tetraploids were not taller or more vigorous than this plant, the polyhaploid had fewer tillers and broader leaves than the tetraploid parents and flowered later. Though the number and length of nodes of the panicle were about the same, the polyhaploid bore a large number of branches at the lower nodes than the $4n$ plants. The polyhaploid plant was thick culmed and had a very poorly developed rhizome. The pollen fertility ranged from 70 to 75% as compared to 74 to 80% in the tetraploids (Table I).

TABLE I

Comparative study of certain morphological characters and pollen sterility between polyhaploid plant and tetraploid plants

Characters	Polyhaploid ($2n=20$)	Tetraploid ($2n=40$)
Height of plant (cm.) ..	190	170–230
Number of tillers ..	26	40–85
Width of leaves (cm.) ..	1·8–2·3	1·3–2·0
Number of panicle branches ..	26–48	21–48
Pollen fertility ..	70–75	74–80

Ten bivalents were normally present at diakinesis and metaphase I in the polyhaploid plant (Fig. 1). However, in 6% of the micro-



FIGS. 1-2. Fig. 1. Polyhaploid *S. halepense* ($2n=20$). Metaphase I, with 10_{II} (× 1,550). Fig. 2. *S. halepense* ($2n=40$). Diakinesis, with $2_{IV} + 15_{II} + 2_{I}$ (× 1,550)

sporocytes $9_{II} + 2_{I}$ were also observed. A low degree of meiotic irregularity was found in the later stages and may, perhaps, account for part of the observed pollen sterility. On the other hand, tetraploid *S. halepense* showed bivalents and quadrivalents (Fig. 2). The range of quadrivalents being 2 to 5 at diakinesis and 0 to 4 at metaphase I, with rare occurrence of tri- and univalents. The average value of chromosome configurations (mean of 20 cells) observed at diakinesis and metaphase I were

$2{\cdot}67_{IV} + 0{\cdot}13_{III} + 14{\cdot}4_{II} + 0{\cdot}16_{I}$ and $1{\cdot}80_{IV} + 0{\cdot}05_{III} + 14{\cdot}55_{II} + 3{\cdot}55_{I}$ respectively.

Studies on the synapsis of chromosomes at pachytene in the polyhaploid, preliminary though they are, have revealed the presence of minute, yet cytologically detectable, structural differences like duplication and non-pairing terminal regions. From this it is easy to discern the wealth of information that could be obtained from a cytological study of hybrids from the polyhaploid and natural diploids as well as those from the artificially doubled polyhaploid and natural tetraploids. This will bring to bear on the complex problem of interrelationship amongst *halepense* genomes, a more complete delineation. Such studies are in progress.

The authors are grateful to Dr. B. P. Pal and Dr. A. B. Joshi for their advice and keen interest. We are also thankful to Dr. M. S. Swaminathan for helpful comments.

Division of Botany, M. L. MAGOON.
Indian Agric. Res. Inst., K. G. SHAMBULINGAPPA.
New Delhi, M. S. RAMANNA.
May 18, 1961.

1. Randolph, L. F. and Fischer, H. E., *P.N.A.S.*, 1929, **25**, 161.
2. Meyer, J. R., *Rec. Genetics Soc. Amer.*, 1954, **23**, 55.
3. Longley, A. E., *J. Agric. Res.*, 1912, **44**, 313.
4. Karper, R. E. and Chisholm, A. T., *Amer. J. Bot.*, 1936, **23**, 369.
5. Huskins, C. L. and Smith, S. G., *J. Genet.*, 1932, **25**, 241.
6. Garber, E. D., *Amer. Nat.*, 1944, **78**, 89.
7. Duara, B. N. and Stebbins, G. L., *Genetics*, 1952, **37**, 369.
8. Krishnaswamy, N., *Indian J. Genet.*, 1951, **11**, 67.

SOME LEAFSPOT DISEASES

DURING the year 1959-60, the authors isolated about six dozen fungi responsible for various leafspot diseases at Allahabad and its neighbourhood. In the present list only those leafspot diseases are included which have not been reported from our country. They have also not been incorporated in any of the lists of Indian fungi[1-3,5] published so far.

The records are summarized in Table I.

The range of the conidial size of the above organisms generally agrees with the range reported for the parent types. Slight variations were, however, observed for *Pestalotiopsis versicolor* where the range of the conidial length was slightly less. The setæ of *Colletotrichum*

TABLE I

Leafspot diseases: hosts, causal organisms, and size of the conidia

Name of the host	Name of the pathogen	Size and shape of the conidia
1. *Kigelia binnata* ..	*Phyllosticta kigeliæ* Died.	9·1–13·3 × 4·4–6·2 μ, hyaline, ellipsoidal, slightly globose
2. *Eriobotrya japonica* ..	*Phyllosticta eriobotryæ* Thuem.	4·9–7·0 × 2·6–3·0 μ, lightly grayish in colour and ellipsoidal in shape
3. *Heliconia rubra* ..	**Phyllosticta dardanoi* Batista	2–3·5 × 1–1·5 μ, hyaline, very small and ellipsoidal
	**Fusarium sambucinum* Fuckel	Macroconidia → 18·7–23·1 × 5·4–7·5 μ, hyaline, fusiform, pointed at both the ends. Microconidia → 3–5 × 1·5–2 μ hyaline
4. *Sansevieria macrophylla* ..	**Fusarium semitectum* Berk. and Rav.	Macroconidia → 11·7–18·2 × 2·6–4·1 μ, pale, sub-clavate, now and then abruptly inflated Microconidia → 3·6–5·4 × 1·5–2·6 μ, hyaline
5. *Eugenia jambolana* ..	**Pestalotiopsis versicolor* (Speg.) Stey.	17–24·7 × 6·8–10·0 μ, coloured cells versicoloured, apical cell with 2–3 setulæ
6. *Quisqualis indica* ..	**Colletotrichum capsici* (Syd.) Butler and Bisby	19–24 × 3·5–5 μ, hyaline, setæ very long
7. *Dracæna terminalis* ..	**Dictyoarthrinium sacchari* (Stevenson) Damon	11–13 × 9–12 μ, dark brown, mostly four celled arranged in cross-like divisions, very rough wall
8. *Elettaria cordamomum* ..	**Nigrospora oryzæ* (Berk. and Br.) Petch	13–15·6 × 8·8–13 μ, black with a hyaline vesicle at the base which may be present or absent
9. *Bassia latifolia* ..	do.	15·9–18·2 × 13–15·6 μ, dark brown or black, vesicle may be present or absent, a highly sporulating form

capsici were generally longer. The conidia of *Nigrospora oryzæ* (isolated from the leaves of *Bassin latifolia*) were remarkable for their larger size and variable shape. The three species of *Phyllosticta* have not been reported from India on any host.

The cultures of the fungi marked (*) have been deposited in Commonwealth Mycological Institute, Kew.

The authors are grateful to Dr. J. C. F. Hopkins, Director, Commonwealth Mycological Institute, Kew, for identification of some of the species.

Botany Department, R. N. TANDON.
Allahabad University, K. S. BILGRAMI.
November 30, 1960.

1. Butler, E. J. and Bisby, G. R., *The Fungi of India—Scientific Monograph No.* 1, Government of India Central Publication Branch, Calcutta, 1931.
2. Mundkur, B. B., *The Fungi of India—Supplement I, Scientific Monograph No.* 12, Government of India Publication, Delhi, 1938.
3. Ramakrishnan, K. and Subramanian, C. V., "The Fungi of India—Supplement II," *J. Madras Univ.*, 1952, **22 B**, 163.
4. Steyaert, R. L., *Bull. Jard. Bot. Brux.*, 1949. **9**, 285.
5. Subramanian, C. V. and Ramakrishnan, K., "List of Indian Fungi—1952-56," *J. Madras Univ.*, 1956, **26 B**, 327.

SCREENING SUGARCANE VARIETIES FOR RESISTANCE TO ROOT KNOT NEMATODE, *MELOIDOGYNE JAVONICA*

NEMATODES, as pests of sugarcane, are now receiving attention in many sugarcane-growing countries. In India, yellowing and growth failure of certain varieties was noticed during 1957[1] in the nematode infested area at Nellikuppam (Madras State). Rangaswami *et al.*[2] recorded two types of nematodes in the area, viz., *Meloidogyne javonica*, causing visible symptoms of root knot and *Tylencorynchus* sp. Rao[3] inoculated sugarcane setts with root knot nematode and found galls developing at the root tips in 7-10 days.

In the Nellikuppam factory area, the sugarcane crop was observed to develop root knots during July-August, i.e., from about the fifth month after planting. Examination of the roots of many varieties revealed varying number of galls on the roots and they could be classified into three categories, viz., (1) mild infestation with few knots; (2) medium infestation with knots readily noticed but not numerous and (3) severe infestation with large number of knots. In certain severely infested varieties like H. 32-8560, symptoms of attack like stunted growth and yellowing of leaves were noticed.

In view of varietal differences in the infestation of nematode as judged from knot numbers, studies were undertaken to see whether varieties could be easily screened for resistance to the nematode infestation.

Nine varieties, three from each of the infestation levels were taken up for the study and ten one budded cuttings in each planted at random in a sand-bed infested with a fairly uniform population of the root knot nematode. Examination of the setts after a week for knot formation revealed distinct varietal responses (Fig. 1). While all the varieties did show terminal knot formation, the relative percent roots recording terminal knots varied with varieties. Knots of varying sizes (1·73 to 4·37 mm. diameter), most of them globular, were observed even in the same variety. The number of larvæ per knot (average of ten knots) varied from 29·3 to 43·9 depending

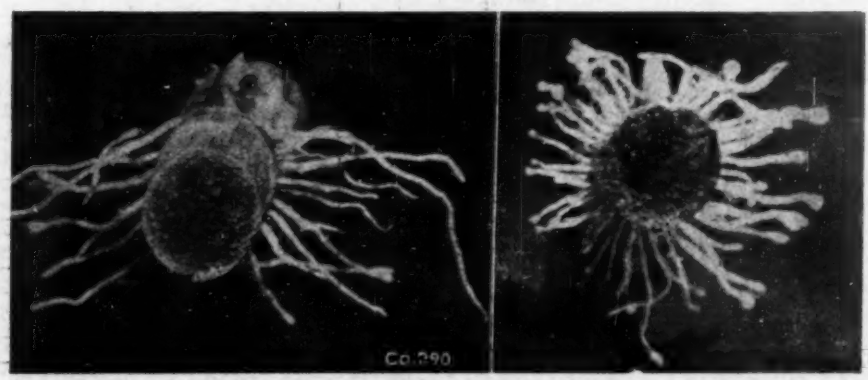


FIG. 1. H 32/8560 showing terminal root knots and Co. 290 comparatively free.

on the size of the knot. No parasitic fungus was found to infect the roots.

The data gathered are presented in Table I.

TABLE I

Percent setts affected and percent roots showing knots

Variety	Visual rating of infestation	Percent setts affected	Percent roots showing knots
Co. 853 ..	Severe	100	32·4±4·5
C.P. 29/116 ..	,,	100	29·0±3·8
H. 32-8560 ..	,,	90	20·9±3·5
Co. 419 ..	Medium	70	10·4±1·8
Co. 449 ..	,,	80	15·0±2·1
Co. 527 ..	,,	80	4·8±1·3
Co. 290 ..	Mild	50	2·5±0·5
Co. 711 ..	,,	80	3·7±1·7
Co. 997 ..	,,	60	4·2±1·3

The relationship between percent roots showing knots and degree of infestation of a variety is generally close. It thus appears possible to compare the degree of infestation among varieties from a knowledge of the percent roots developing knots.

One week rooted single eyepieces thus appear to be good indicators of varietal infestation to root knot nematode and that rapid screening of seedling varieties is possible by this method. No structural differences were noticed in the anatomy of roots as between varieties with varying infestation levels.

Thanks are due to Dr. N. R. Bhat, Director, for interest, encouragement and advice in the preparation of the note.

Sugarcane Breeding Inst., U. VIJAYALAKSHMI.
Coimbatore-7, J. T. RAO.
May 17, 1961.

1. David H., *Ind. Jour. Sug. Res. and Dev.*, 1957, **3**, 234.
2. Rangaswami, G., Vasantharajan, V. N. and Venkatesan, R., *Curr. Sci.*, 1960, **6**, 236.
3. Rao, G. N., *Sci. and Cult.*, 1961, **27**, 94.

GALL MIDGE ASSOCIATED WITH SUGARCANE INFLORESCENCE

DURING the last hybridisation season, while attempting to use one of the improved hybrid varieties, Co. 951, in breeding as a pistillate parent (it is a male sterile variety) it was noticed that the ovary and stylar branches in many of the spikelets were being injured by an insect. Closer examination revealed the presence of short, oval-shaped, orange-coloured segmented larvæ which fed on the ovarian tissue and were later attached to the style (Fig. 1). Over 50% of the younger spikelets

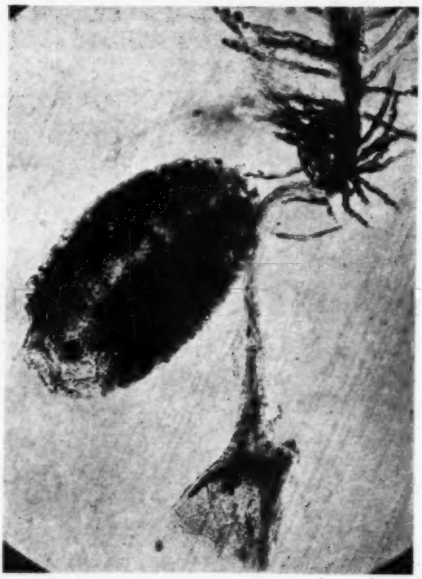


FIG. 1. Note damaged ovary and larva attached to style.

in an arrow were noticed to be thus infested. In the older ones, adult-winged insects were noticed in fairly large numbers. The presence of the larvæ and the adult in one and the same arrow led to the belief that the insect is not a casual visitor but is actually phytophagous feeding and breeding on the spikelets.

Seeds collected from the arrows were noticed to be black in appearance and failed to germinate. This may be due presumably to the under-nourishment of the developing embryo caused by the feeding of the insect on the ovarian tissue.

The insect has been identified as a gall midge of the genus *Contarinia*. According to Barnes[1] no gall midges have been recorded on the sugar plants, sugarcane or sugar-beet. This is presumably the first record of gall midge associated with sugarcane and injurious to its normal seed development. The midge can be a potential nuisance to the sugarcane breeder inasmuch as it has rendered the variety Co. 951 sterile and useless as a genetic stock.

So far only Co. 951 has been noticed to be attacked by the midge and none of the many varieties in its close proximity. Also the variety was found to be infested in various parts of the field. The possible explanation for this varietal

preference may be that Co. 951 flowers very late and is in full bloom when other varieties have practically finished arrowing and have only late stray arrows on them. Probably, the flowering period in Co. 951 might have coincided with the period of maximum flight of the midge. Such an association has been noticed in many crops (Barnes, *loc. cit.*).

Grateful thanks are due to Miss Margaret K. Arnold of the Rothamsted Experiment Station, England, for identification of the midge. Thanks are offered to Dr. N. R. Bhat, Director, and Dr. J. T. Rao, Botanist, for their interest and encouragement.

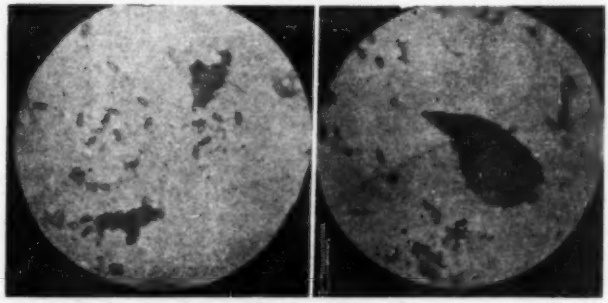
Sugarcane Breeding Institute, A. S. ETHIRAJAN.
Coimbatore-7,
May 2, 1961.

1. Barnes, H. F., *Gall Midges of Economic Importance*, 1949, **6**.

OCCURRENCE OF ROOT-KNOT NEMATODES ON BETELVINE IN MAHARASHTRA

BETELVINE (*Piper betel* L.) is one of the important cash crops in Maharashtra. It is being grown throughout the State in localized areas wherever soil and climatic conditions are favourable. In recent years, wilt caused by root-knot nematodes (*Meloidogyne incognita* var. *acrita* Chitwood, 1949) was observed at Vadner Bhairao (Dist. Nasik) causing considerable damage to betelvine. Examination of affected specimens from many places in the State revealed that the disease was caused by root-knot nematodes inciting galls on betelvine roots. Microscopic examination of the galls revealed the presence of eggs, larvæ, males and females of nematodes in the vascular bundles of roots. Samples of root-galls were sent to Dr. F. G. W. Jones, Nematologist, Rothamsted Experimental Station, Harpenden, Herts, England, who kindly identified them as belonging to the species *Meloidogyne incognita* var. *acrita* Chitwood (1949). A similar damage to betelvine suspected to be caused by nematodes is also reported from Madras in 1926.[1]

The first visible symptom of the disease is blackening and dropping of the growing tip of betelvine during the month of October. When the disease develops the entire betelvine shows sickly appearance, leaves turn pale-yellow in colour, droop and fall to the ground. Ultimately the entire vine wilts. Root galls varying in size and shape are formed. These ultimately decay in the soil liberating millions of eggs, larvæ and females every year. Thus the nematode population in the soil increases and ultimately the soil becomes unfit for growing betelvine. When a root-gall is cut open, egg masses are observed as whitish, glistening, round, pin-point-like bodies embedded in the root tissues. If a small portion of this material is examined under the microscope eggs, male and female can be observed (Fig. 1 *a*). The female is pyriform (Fig. 1 *b*) in shape while the males are filiform and in general outline differ from the larvæ.



a *b*

FIG. 1. (*a*) Eggs and larvæ of nematodes, × 80. (*b*) Female of nematodes, × 80.

During the last three years experiments to control nematodes were conducted with non-phytotoxic soil fumigants, nematicides and insecticides. Diazinon (Basudin) a phosphorus containing compound has given promising results in controlling root-knot nematodes. Detailed account is being published elsewhere.

Grateful thanks are due to Dr. B. S. Kadam, Joint Director of Agriculture, Poona, for his guidance and valuable suggestions, and to the

Indian Council of Agricultural Research, New Delhi, for financing the scheme.

Plant Pathology Section, College of Agriculture, *Poona*-5, May 26, 1961.

G. W. DHANDE.
M. SULAIMAN.

1. Krishna Ayyar, P. N., *Madras Agri. J.*, 1926, **13**, 113.

A BACTERIAL LEAFSPOT DISEASE OF JASMINE

DURING 1958–61 the jasmine plants (*Jasminum sambac* Soland) in the Annamalainagar area of Chidambaram, Madras State, were found affected by a bacterial leafspot disease. The same disease has also been observed in some parts of Salem and Coimbatore districts during the same years. Both the bushy and climber types of varieties of jasmine were found affected. The disease symptoms first appear as minute water-soaked lesions on the upper surface. These lesions soon become yellowish-green and enlarge in size. Several spots coalesce to form linear or irregular spots, which give a characteristic mosaic-like appearance to the leaf (Fig. 1). On each leaf several spots may appear in a crowded form but in some varieties there may be only a few localized spots. No other plant parts appear to be affected by the bacterium. In the case of severely affected plants there is defoliation and stunted growth of the plants. Transverse sections of the leaves through the affected tissues clearly indicated the presence of the bacterial cells in the affected tissues. The bacterium was brought into culture by the tissue culture method and was purified by the single colony method. When inoculated on healthy plants of different jasmine varieties by spraying the bacterial suspension on the leaves, infections were obtained, the symptoms becoming visible after seven days. The bacterium was reisolated from the lesions and was found to be identical with the original inoculum.

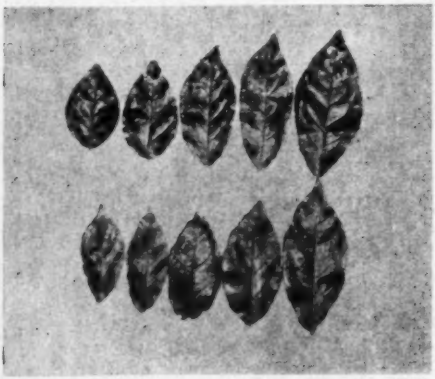


FIG. 1. Leafspots on *Jasminum sambac* Soland caused by *Xanthomonas jasminii*, Rang. and Esw., sp. nov.

Elliott[1] has listed *Jasminum primulinum* Hemsl. as one of the several hosts for *Pseudomonas savastanoi* (E.F.Sm.) Stevens and *P. syringæ* van Hall. There appears to be no earlier report of any bacterial disease on any species of *Jasminum* in India. The bacterium under the present investigation differs considerably from those mentioned above in its morphological, physiological and biochemical as well as pathological characters and is therefore named *Xanthomonas jasminii*, sp. nov.

Xanthomonas jasminii RANGASWAMY AND ESWARAN, SP. NOV.

Short rods, $2{\cdot}1–4{\cdot}2 \times 0{\cdot}7–1{\cdot}4\,\mu$, single, rarely in chains of two or three, monotrichous with single polar flagellum, aerobic, non-acid fast, Gram-negative, non-capsulated and non-spore-forming. Forms flat, circular, entire opaque and non-glistening yellow colonies on nutrient agar and yellow growth with sedimentation in nutrient broth. No soluble pigment is produced in the liquid or agar media. Gelatin is liquefied rather slowly, but starch is hydrolysed rapidly and litmus milk is coagulated with acid production, but litmus in the milk not reduced. H_2S is not produced by the bacterium, but ammonia produced; gives positive M.R. and lypolytic activity tests and negative indol and V.P. tests. Utilizes glucose, sucrose, maltose, lactose, raffinose, rhamnose, galactose, xylose and levulose as carbon sources, with acid production but no gas formation; also utilizes potassium nitrate, ammonium dihydrogen phosphate, urea, glutamic acid, aspartic acid and tryptophane as nitrogen sources.

Causes leafspot on *Jasminum sambac* Soland and on artificial inoculation failed to infect *Zinnia elegans* Jacq., *Tagetas erecta* Linn., *Cosmos sulphurens* Cav., *Impatiens balsamina* Linn., *Hibiscus rosasinensis* Linn., *Antigonum leptopus* Hook. and Arn., *Justicia* sp., *Crossandra undulæfolia* Salisb., *Nerium odorum* Soland, *Euphorbia pulcherima* Willd., and *Canna indica* Linn.

Department of Agriculture, Annamalai University, Annamalainagar, Madras State, *May* 11, 1961.

G. RANGASWAMI.
K. S. S. ESWARAN.

1. Elliott, C., *Manual of Bacterial Plant Pathogens*, Waltham, Mass., U.S.A., 1951.

CASSIA TORA: LOCAL LESION HOST OF TOBACCO MOSAIC VIRUS

DURING study of comparative host ranges of four different virus diseases of plants reported from India, *Cassia tora*, a commonplace weed, was observed to produce dark-brown local necrotic lesions in 8 to 10 days after inoculation with the Johnson's tobacco virus 1 (tobacco mosaic virus).[1] Experiments were carried out to compare the local lesions formed on leaves of *Cassia tora* inoculated with and without an abrasive, diluted and undiluted juice of tobacco leaves, and on test plants preconditioned in dark and those grown in full daylight.

At least 10 times more lesions are formed on *Cassia tora* plants preconditioned in dark for 4 days before inoculation than on those grown continuously in light.[2] Lesions begin to appear after 4 days and are well developed within 10 days. They are about 2 mm. in diameter to begin with but slightly enlarge, broaden, and grow deeper in colour with age. They, however, do not coalesce but necrosis may develop sometimes along the veins (Fig. 1). Systemic infection in *Cassia tora* does not occur. Preliminary studies have shown that *Cassia tora* is useful local lesion and differential host plant of the type strain of tobacco mosaic virus (TMV). Further studies are in progress.

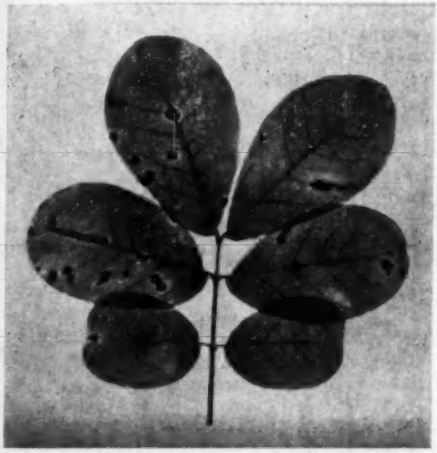


FIG. 1. Leaf of *Cassia tora* showing local necrotic lesions of TMV. (Photo 15 days after inoculation.)

Earlier records show that cassia virus, strains of tobacco etch virus, potato virus Y, and Black-eye cowpea mosaic virus[3], tobacco ringspot virus, tomato ringspot virus, and potato virus X[4], and Cymbidium mosaic virus[5] induce formation of local necrotic lesions or spots on leaves of *Cassia tora* plants.

This study is the first report of infection caused by the type strain of TMV in *Cassia tora*. Brooks[6] and Anderson[3] failed to infect *Cassia tora* with tobacco mosaic virus in repeated attempts.

Indian Agric. Res. Institute, S. P. CAPOOR.
Plant Virus Res. Laboratory,
Poona-5, *March* 23, 1961.

1. Johnson, J., "The classification of plant viruses. Wisconsin," *Agr. Expt. Sta. Res. Bull.*, **1927, 76.**
2. Bawden, F. C. and Roberts, F. M., *Ann. Appl. Biol.*, **1948, 35,** 418.
3. Anderson, C. W., *Plant Dis. Reporter*, **1954, 38,** 736.
4. —, *Ibid.*, **1958, 42,** 932.
5. Corbett, M. K., *Phytopathology*, **1960, 50,** 346.
6. Brooks, A. N., *Florida Agr. Exp. Sta. Ann. Report*, **1937, 1936,** 94.

A SIMPLE METHOD OF DETERMINATION OF GLYCOGEN CONTENT OF MARINE ANIMALS

A RAPID method for the determination of glycogen in animals was described by Van Der Kleij (1951)[1] as well as Kemp and Heijningen (1954)[2] which involved the hydrolysis of glycogen obtained after precipitating the proteins with cold trichloroacetic acid, and determining the sugar by the spectrophotometric method described by Mendel and Hoagland (1950).[3] This method has been used for the determination of the glycogen content of marine animals by Lane, Posner and Greenfield (1953)[4] and Raymont and Krishnaswamy (1960).[5] This is however sensitive for sugar levels ranging from 50 to 150 μg. per ml. In the course of a study of the glycogen content of the marine wood-boring pholad *Martesia fragilis* it was found that the glycogen content was very high. Hence the procedure had to be modified so that the resultant colour produced after the addition of sulphuric acid could be read in a photo-electric colorimeter using a blue filter instead of in a spectrophotometer.

The sample was ground with chemically pure sand and cold 5% trichloroacetic acid containing 0·2% silver sulphate, as in the case of marine animals it was found that 0·1% silver sulphate was not sufficient. The rest of the procedure was essentially the same as described by previous workers.[1–3,5,6] The extract was transferred into a centrifuge tube, made up to 5 ml. and boiled for 15 minutes, cooled in running tap-water and centrifuged. The glucose determination was carried out after addition of 1 ml. of the supernatant solution to 3 ml. of concentrated H_2SO_4 (Analar grade). The material

was then boiled for 6·5 minutes in a water-bath and cooled immediately in running tap-water. Standards were prepared containing glucose ranging from 250 to 1,000 μg. per ml. The colorimetric readings showed a linear relationship up to 750 μg. and followed Lambert Beer's law. Beyond this concentration (*i.e.*, 750 μg.) the graph takes a steep upward rise which was not predictable. The experiments were repeated using a spectrophotometer at 520 mμ wavelength for both the animals and standards and the sugar content read out from the graphs. The glycogen content expressed in terms of sugar for animals of different sizes vary. However, the results obtained by using the two different methods gave the same values and showed that the colorimeter could be conveniently used for the determination of higher concentrations of glucose (*i.e.*, beyond 150 μg. and up to 750 μg.).

We wish to thank Dr. E. R. B. Shanmugasundaram, Head of the Department of Biochemistry, Madras University, for critically going through the paper and Prof. T. S. Sadasivan, Professor of Botany, University of Madras, for permitting us to use the spectrophotometer.

Zoology Research Lab., V. V. SRINIVASAN.
University of Madras, S. KRISHNASWAMY.
Madras, *April* 28, 1961.

1. Van Der Kleij, B. J., *Biochem. biophys. Acta*, 1951, **7**, 481.
2. Kemp, A. and Van Kits Heijningen, A. J. M., *Biochem. J.*, 1954, **56**, 646.
3. Mendel, B. and Hoagland, P. L., *Lancet II*, 1950, **1**, 16.
4. Lane C. E., Posner, E. G. S., and Greenfield, L. J., *Bull. Mar. Sci. Gulf. Carrib*, 1953, **2** (2), 285.
5. Raymont, J. E. G. and Krishnaswamy, S., *J. Mar. biol. Ass. U.K.*, 1960, **39**, 239.
6. Mendel, B., Kemp. A. and Myers, D. K., *Biochem. J.*, 1954, **56**, 639.

NEW HOST PLANT OF COLOCASIA BLIGHT (*PHYTOPHTHORA COLOCASIAE* RACIB.)

BLIGHT caused by *Phytophthora colocasiæ* Racib. is known to be a serious disease of Colocasia (*Colocasia antiquorum* Schott.), in India, during the monsoons (Butler, 1918). There are no other naturally occurring host plants of this disease (Butler and Bisby, 1931).

In 1959, during the months of August and September, at the Central Potato Research Station, Patna, young plantations of elephant-foot yam (*Amorphophallus campanulatus* Blume), an important vegetable crop in many parts of India, were observed to be severely attacked by a foliage blight. Microscopic examination of the disease tissues revealed the presence of sporangiophores and sporangia of Phytophthora which, on the basis of morphology, was identified as *Phytophthora colocasiæ* Racib. During 1960 Kharif season, elephant-foot yam was planted with Colocasia to study the occurrence of Colocasia blight on elephant-foot yam. In July, blight first appeared in an epiphytotic form on Colocasia. Within a fortnight, disease spread to elephant-foot yam, growing near the infected plants of Colocasia. Cross-inoculation tests were undertaken during August and September. The authors were able to transmit the disease repeatedly from Colocasia to elephant-foot yam and *vice versa*, by using fresh sporangial suspension on the detached leaves and young potted plants in the moist chambers. All the inoculated leaves developed typical symptoms of blight within 36-72 hours and produced sporangiophores and sporangia on the diseased spots.

Since the disease on elephant-foot yam has not been reported, an annotated account of the symptoms, and the fungus associated with it, is presented.

In early stages the disease is manifested by the appearance of light-brown, water-soaked, necrotic, round to regularly-shaped lesions on the leaf. The margins are often zonated in different shades of brown, green and yellow. In later stages they enlarge and usually coalesce, involving large part of the leaf area. The severely affected leaves shrivel and dry up. Frequently the petioles are also infected. The intensity of attack depends, as in potato blight [*Phytophthora infestans* (Mont.) deBary], on the atmospheric conditions. The intensity of blight was greater in shady places than in open fields.

The detailed examination of diseased lesions showed that infection is mainly by zoospores. The germ tubes penetrate both through the stomata and epidermis and give rise to profusely branched mycelium, which rapidly spread in the intercellular spaces of the leaf. From the internal hyphæ, sporangiophores emerge singly through the stomata and epidermis. The sporangia are hyaline, elliptical, very irregular in size (35–50 × 20–25 μ) and are borne singly at the tip of very short, narrow and unbranched sporangiophores. No other spore forms were found on Colocasia and elephant-foot yam.

The authors are grateful to Dr. Pushkarnath, Director, Central Potato Research Institute, Simla, for providing facilities of work.

Central Potato Res. Station, K. D. PAHARIA.
Patna (Bihar), P. N. MATHUR.
May 25, 1961.

1. Butler, E. J., *Fungi and Diseases in Plants*, Thacker, Spink & Co., 1918.
2. —, and Bisby, G. R., *Fungi of India*, I.C.A.R. Science Monograph (Revised by R. S. Vasudeva), 1960.

REVIEWS

Theory of Probability. By William Burnside. (Dover Publications, New York). Pp. xxx + 106. Price $ 1.00.

Theory of Probability is the synthesis and expansion of a number of individual papers published by Burnside over a period of years. Printed posthumously, it is the expression of his views so far as they were framed into a system. Though this work does not resolve all the difficulties of the problem, it is a remarkable work by a distinguished scholar, throwing light on many difficult concepts.

This essay, unavailable for many years, presents numerous problems in classical probability which offer many original views on the subject. They include discussions of the game theory, progressive games with counters, cards, selections from groups, spinning of a coin, division of lines, games of substituting for drawn objects, and similar topics. Geometrical probability is treated in such areas as: suppositions as to probability of position of a point on a line, points on the surface of a sphere, and Poincare's problem on the probable number of intersections of two closed curves on a sphere.

Besides the book contains a thirty-page biographical memoir of Burnside.

V.

Meson Physics. By Robert E. Marshak. (Dover Publications, Inc., New York), 1959. Pp. viii + 378. Price $ 1.95.

The book had its inception in a series of lectures given by the author at the universities of Rochester and Columbia, and appeared first in the year 1952. The subject-matter of the volume has by no means acquired a final character and that is perhaps one of the reasons for the enormous activity in the field. There is a need for a book comprising the important results that are available only in research papers, and the present one satisfied this admirably.

The first four chapters of the volume elucidate the behaviour of charged and neutral π mesons at non-relativistic nucleon energies, with special attention being given to the accelerator experiments which were increasingly more incisive in their determination of the properties of the π mesons. Chapters 5 and 6 draw attention to the striking contrasts between π and μ mesons. Chapter 7 deals with the characteristic problems associated with the nuclear interaction of π mesons. Chapter 8 discusses π meson production phenomena at relativistic nucleon energies. Chapter 9 discusses the theoretical difficulties created by the discovery of new classes of particles, like heavy mesons and hyperons.

A. J.

Cambridge University Press Publications : (The Bentley House, 200, Euston Road, London, N.W. 1) :—

1. *The Mathematical Theory of Electricity and Magnetism.* By Sir James Jeans. Pp. 652. Price 25 *sh.* (Paper bound).
2. *The Mathematical Theory of Relativity.* By A. S. Eddington. Pp. 270. Price 16 *sh.* (Paper bound).
3. *The Mathematical Theory of Non-uniform Gases.* By S. Chapman and T. G. Cowling. Pp. 431. Price 17 *sh.* 6 *d.* (Paper bound).
4. *Elementary Matrices.* By R. A. Frazer, W. J. Duncan and A. R. Collar. Pp. 416. Price 17 *sh.* 6 d. (Paper bound).

These four publications of the Cambridge University Press are well known treatises on the subjects concerned and have been so popular with students and teachers through these years that frequent reprints were necessitated since their original publication three, four or five decades ago. The C.U.P. are doing a good service to the English-speaking student community of the Universities all over the world, in making these classics now available in cheap paper cover editions.

Sir James Jeans' treatise is the standard general work on electricity and magnetism and covers the topics in electromagnetic theory in simple mathematical language.

In the book on Relativity, Sir Arthur Eddington, in his characteristic clear style, formulates mathematically the new conception of the world of physics arising out of the theory of relativity and follows out the consequences to the fullest extent.

Chapman and Enskog deal mainly with the mathematical theory of transport phenomena—viscosity, thermal conduction, and diffusion—in non-uniform gases, based on Maxwell-Boltzmann equations. The later chapters deal with the quantum theory of the transport phenomena, and electromagnetic phenomena in ionized gases.

The well-known text-book on *matrices* by the three authors starts with the first principles and develops the subject with special reference to its applications to differential equations and classical mechanics. Though the title states that the book is elementary, discussions of advanced questions and complicated problems are also included thus making the book more useful. Worked numerical examples taken from aerodynamics have a considerable practical importance. A. S. G.

Impulse Voltage Testing. By W. G. Hawley. (Published by Chapman and Hall Ltd.), 1959. Pp. viii + 183. Price 32 *sh.*

This monograph is an outcome of the author's efforts to pool the information about impulse voltage technique and testing, scattered in a large number of research papers and specifications, into a convenient form for teaching this art in Engineering Schools and Colleges and, particularly, to the industrial laboratory staff engaged on this class of work.

The first three chapters deal pertinently with the significance of impulse voltage testing, impulse withstand voltage values for power system apparatus and definitions relating to the testing. In Chapter 3, the basic theory of impulse circuits is presented. Of course, an elementary knowledge of Heaviside Operational Calculus is assumed from the reader. The next four chapters describe, at length, single- and multi-stage impulse generators giving relevant design considerations and some details of its auxiliary equipment. It is surprising to note that no mention is made about the role of stray capacitances in the successful firing of the multi-stage impulse generator while explaining its mechanism in Chapter 6. An elementary account of measurement and recording of impulse voltages is given in Chapters 9 to 12. For finer points of measurement the reader is referred to the original papers. The testing of overhead power line insulators, power transformers, overhead transmission lines, power cables and power capacitors is described in Chapters 15 to 19. There is also a chapter on correction for atmospheric conditions. Relevant information about testing procedures is liberally extracted wherever applicable from I.E.C. specifications. Last chapter indicates miscellaneous applications of the impulse testing. There are eight appendices giving useful information about items like the earthing by means of buried electrodes, Silko resistance ribbons, etc.

On the whole, this book provides a comprehensive and up-to-date coverage of the art of impulse voltage testing of all power system apparatus that are exposed to severe transient over-voltages of atmospheric origin. No account of testing of lightning arresters is given on the ground that the impulse test is more in the nature of a heavy current test. But in view of the increasing importance of the knowledge of the volt-time characteristic of the series gap of the lightning arresters for the purpose of insulation co-ordination it is hoped that the standard wave test of the lightning arresters will be included along with the technique of measurement of front-chopped impulse voltages in future edition. It will be useful if the recent revisions made in the relevant international specifications are incorporated in the future edition. An additional appendix on impulse current testing of the lightning arresters will enhance the worth of the monograph.

There are a few misprints in the present publication but they are fairly obvious (pages 10, 18, 78, 79 and 92).

As the first book in English devoted exclusively to this subject it is a worthy addition to the 'popular series of Monographs on Electrical Engineering'.

D. J. Badkas.

Advances in Analytical Chemistry and Instrumentation, Vol. I. By C. N. Reilley. (Interscience Publishers, New York), 1960. Pp. 445. Price $ 12.00.

The seven chapters of this volume, written by authorities in respective fields, are of great value to the research chemists.

The first chapter on tetraphenylboron as an analytical reagent by Flaschka and Barnard not only includes a detailed account of the different methods employed in the determination of potassium with TPB, but also other diverse uses of TPB in inorganic and organic analyses. The chapter is well written and references to the literature have been cited extensively. The chapter on gas chromatography detectors by Seligman and Gager is an excellent review wherein the authors make an evaluation of the various methods of vapour detection. The advantages in using high sensitivity ionization devices, hydrogen flame detectors and radiological detectors have been discussed. The recent methods for the determination of fluorine in inorganic compounds have been discussed by Horton in Chapter 3. The methods of analysis of organic fluorine compounds have been completely omitted. Horton points out the need for further research on several aspects of the methods of determination of fluorine. The

fourth chapter on organic microanalysis by Schöniger deals with handling of the latest type of microbalance, inclusive of setting of table, mode of weighing, etc., critical evaluation of latest methods of combustion for the estimation of different elements separately as well as simultaneously. Reinmuth has written the chapter on theory of electrode-processes with emphasis on electroanalysis and has discussed the nature of electrode reactions, experimental techniques and the effects of experimental variables on electrode processes. The use of thioacetamide in inorganic analysis is the subject-matter of a chapter by Swift and Anson. The use of thioacetamide in inorganic analysis will undoubtedly gain more importance in future and may even completely replace the conventional methods employing hydrogen sulphide. The qualitative and quantitative applications of near-infra-red spectrophotometry (1-3 μ region) in chemical analyses have been discussed in a clear and concise manner by Goddu in the last chapter of this volume, and this may be considered particularly valuable in view of the current availability of several instruments of excellent make.

D. K. Banerjee.
C. N. R. Rao.

The Chemistry of the Terpenes. By A. R. Pinder (Chapman and Hall Ltd., 37, Essex Street, London, W.C. 2; India: Asia Publishing House, Bombay-1), 1960. Pp. vii + 223. Price 50 *sh.*

The object of writing this book by Professor Pinder is to acquaint the Honours undergraduate students with the essentials of terpene chemistry, which would also include recent developments in the field, while restricting its volume within a reasonable limit, and this has undoubtedly been achieved. The whole subject has been systematically presented with emphasis on degradation reactions, syntheses, and molecular rearrangements involved in its chemistry. Recent developments in the stereochemistry and biosynthesis of terpenes have not been ignored. There have been few notable omissions, *e.g.*, prominent reference to Woodward's contribution to biosynthesis, syntheses of irone, reference to Bhattacharyya in connection with the synthesis of podocarpic acid, etc.

D. K. Banerjee.

Comparative Biochemistry, Vol. I. *Sources of Free Energy.* Edited by M. Florkin and H. S. Mason. (Academic Press, New York and London), 1960. Pp. xxv + 590. Price $ 18.00.

In recent years the importance of comparative biochemistry is being increasingly recognized and an attempt is made in the first volume of this comprehensive treatise to consider the structural and functional similarities and diversities among living organisms from the molecular level.

The volume begins with an introduction to comparative biochemistry written by the editors Florkin and Mason wherein they elaborate two important concepts, namely, that life is consistent with the fundamental properties of matter and energy and is a consequence of them and secondly that there is a common ground plan of composition and metabolism and superimposed on these are numerous secondary adaptational variations.

The second article by Byring, Boyce and Spikes discusses the basic principles of classical thermodynamics and the steady state systems which are of particular interest to living organisms. The theory of absolute reaction rates which can be used as a complementary approach to the study of living systems is also clearly explained.

In their review on the comparative mechanisms of fatty acid oxidation Stumpf and Barber consider the β-oxidation of fatty acids as the common denominator on which are superimposed the variants that have developed in different tissues and in different phyla in response to their specific needs.

Energy-yielding reactions and 'energy-rich' compounds which are potential energy reserves in living systems are reviewed by Huennekens and Whiteley who discuss the chemical and thermodynamic aspects of energy-rich compounds and point the way to further developments.

The present state of our knowledge of the chemical properties of onium compounds and their natural distribution is summarized by Cantoni who has made valuable contributions to the biochemistry and intermediary metabolism of this type of compounds. The chemistry of onium compounds, energetics of the onium bond, transfer reactions from an onium pole and the enzyme mechanisms in the formation of the onium bond are all described in great detail.

The phenomena of phototropism and phototaxis, the role of auxins in phototropism in plants and the nature of photoreceptors are discussed by Thimann and Curry, while Wald contributes a stimulating article on the distribution and evolution of visual systems.

Fromageot and Senez give a survey of the biochemical processes which produce free

energy from inorganic substances. The oxidation of nitrogen and sulfur compounds and of molecular hydrogen are described in this chapter and their relative importance as the energy-yielding reaction in different phyla critically examined.

The last three chapters pertain to the comparative biochemistry of glycolysis, electron transport and oxidative phosphorylation and the utilization of thermal energy by living organisms.

This volume fills a real need in giving a critical and most satisfactory survey of a field which is rapidly growing in importance and can be unreservedly recommended as an indispensable reference volume for advanced students and research workers in comparative biochemistry.

P. S. SARMA.

Royal Institute of Chemistry, Monographs for Teachers

No. 4. *Principles of Metallic Corrosion.* By J. P. Chilton. Pp. 64. Price 6 *sh.*

No. 5. *Principles of Chemical Equilibrium.* By P. G. Ashmore. Pp. 49. Price 4 *sh.* 6 *d.*

These are the titles of the fourth and fifth items in the series of *Monographs for Teachers*, published by the Royal Institute of Chemistry and sponsored by the Institute's Fund for the Development of Education in Chemistry.

These publications are intended for the guidance of those who teach chemistry at G.C.E. Advanced level and above, but the monographs will doubtless be of value to a wider readership, including more advanced students of chemistry.

Copies may be obtained from the Royal Institute of Chemistry, 30, Russell Square, London, W.C. 1.

D. G. C.

Cellulose Research Symposium, (II)—1958. (The Council of Scientific and Industrial Research, Rafi Marg, New Delhi-1), 1960. Pp. xii + 156. Price Rs. 12.

This publication of twenty-seven papers on Cellulose Research read and discussed in four sessions at the Second Symposium held in the Forest Research Institute, Dehra Dun in 1958, by the Council of Scientific and Industrial Research, New Delhi, gives not only to the research worker a scope for further studies but also to the Cellulose allied industries a probe into the possibilities of manufacture of their products by new techniques which will go a long way to solve the problem of our country's shortage of cellulose raw materials. Industries like the Jute, Paper and Rayon should encourage such furtherance of knowledge on Cellulose Research to their mutual advantage by contributing to the Institutions conducting such research and giving them specific problems to solve.

The structure and physical properties of cellulose, the chemistry and technology have been well brought out in the few papers published but their successful application in the manufacture of Newsprint and Viscose Rayon is yet to be a 'fait accomplie'. Of the short fibred hardwoods the possibility of manufacture of writing and printing papers from wattle wood is explained in one paper. But the use of this raw material can only be restricted as the pulp from wattle wood should be mixed up with at least 50% of longer fibred pulp like bamboo pulp before they can be run trouble free on a high speed machine as per trials conducted at the Mysore Paper Mills, Bhadravati. Since our country is facing acute shortage of Cellulose raw materials for all the allied industries, research and pilot plant trials on the choice of fresh raw materials from easily and quickly growing Hard Wood and their successful application to the Industry for the manufacture of Paper and Viscose Rayon is now of utmost importance.

V. K. S.

Biological and Chemical Control of Plant and Animal Pests. A Symposium presented by Section O on Agriculture at the Indianapolis Meeting of the American Association for the Advancement of Science, December 28-30, 1957. Pp. 273. Edited by L. P. Reitz. (Publication No. 61 of the American Association for the Advancement of Science, Washington, D.C.), 1960. Pp. 285. Price $ 5.75.

The book is a symposium purporting to give a survey of what has been accomplished in the past 25 years in the field of disease and pest control through Chemical and Biological means. It also touches on the aspect of what may be done in future in this direction.

The symposium is presented in three parts with papers written by specialists based on extensive review of literature in each field. References are listed at the end of each chapter for further consultation.

Part I consisting of five papers is devoted largely to impress on the reader the stake every citizen has in pest and disease control and it includes topics like National Policy—Eradicating programmes—Control of insects and diseases in forests—Need of public co-operation in achieving the programmes, etc.

The four papers in Part II deal with the recent concepts and developments about chemicals (Insecticides, fungicides and weedicides)—their mode of action as killing agents on weeds, disease organisms and insects, as well as internal animal parasites.

Part III refers to biological control of pests and comprises nine chapters. It treats exhaustively the interdependent nature between predators—antagonists—parasites and the environment. Mention is also made on the aspect of breeding for resistance. The author hints that biological control, though less dramatic than chemical control, is the ideal way to control pests as it precipitates no residual problems.

Within the framework of the above objects there is no doubt that the book is valuable with contributions from experts on related fields. The manner in which the problem is approached and the style in which it is presented evokes praise as every point that the writer desires to make out has been driven home conclusively.

However, the whole of the efforts relates to work done in the U.S.A. and the reader would look for any work done in other countries in the several fields as conditions in these countries would naturally differ from the American conditions as also pests and diseases.

M. PUTTARUDRIAH.

Principles of Animal Virology. (2nd Edition). By F. M. Burnet. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1960. Pp. ix + 490. Price $ 12.00.

Sir Macfarlane Burnet's book is well known and it remains as one of the best text-books on Animal Virology. Rapid progress in virus research during the past few years, has justified a revision of the book. Nearly half the book has been rewritten omitting a chapter of the earlier edition. Apart from the physical and chemical properties of viruses, multiplication and liberation of virus from the host cells and its interference and pathogenesis, evolution and ecology of viruses are discussed in sufficient detail. The book has been written with inferences drawn from selective references, but this does not in anyway minimise the value of the book. In fact this approach to the subject should prove more useful both to the student and the research worker alike.

V. N. K.

Books Received

General Physical Science. By G. G. Mallinson, J. B. Mallinson and R. F. Welch. McGraw-Hill Book Co., New York), 1961. Pp. xii + 628.

A Text-Book of Inorganic Chemistry. By A. K. De. (Science Book Agency, P. 133, Lake Terrace, Calcutta-29). Pp. viii + 503. Price Rs. 11.

Text-Book of Organic Chemistry—Parts I and II. By P. C. Bhattacharya. (Mrs. Gowri Bhattacharyya, P.O. Agarpara, North Station Road, 24 Parganas), 1961. Part I: Pp. vii + 315. Part II: Pp. vii + 250. Price Rs. 7. each part.

A Dictionary of Named Effects and Laws—in Chemistry, Physics and Mathematics (2nd Revised Edition). By D. W. G. Ballentyne and L. E. Q. Walker. (Chapman and Hall, 37, Essex Street, W.C. 2; India: Asia Publishing House, Bombay-1), 1961. Pp. v + 234. Price 30 *sh.*

Review of Food Technology (Vol. 2). (The Association of Food Technologists, Mysore-2), 1961. Pp. xvii + 168. Price Rs. 7·50.

Oceanography. Edited by M. Sears. (American Association for Advancement of Science, Washington, D.C., 1961. Pp. xi + 654. Price $ 14.75.

From: (John Wiley and Sons Ltd., 440, Park Avenue South, New York-16; India: Asia Publishing House, Bombay-1).

Quantum Mechanics. By E. Merzbacher, 1961. Pp. xii + 544. Price $ 12.00.

Elementary Fluid Mechanics (4th Edition). By J. K. Vennard, 1961. Pp. xiv + 570. Price $ 7.95.

Error Correcting Codes. By W. W. Beterson, 1961. Pp. x + 285. Price $ 7.75.

From: (Academic Press Inc., 111 Fifth Avenue, New York-3, N.Y.; India: Asia Publishing House, Bombay-1).

Measure, Lebesgue Integrals and Hilbert Space. By A. N. Kolmogorov and S. V. Fomin, 1961. Pp. xii + 147. Price $ 4.00.

Advances in Morphogenesis (Vol. 1). Edited by M. Abercrombie and J. Brachet, 1961. Pp. xiii + 445. Price 89 *sh.* 6 *d.*

Name Reactions in Organic Chemistry (2nd Edition). By A. R. Surrey, 1961. Pp. x + 278. Price $ 8.00.

From: (Cambridge University Press, 200, Euston Road, London, N.W. 1).

Partial Differential Equations of Mathematical Physics. By H. Bateman, 1959. Pp. xxii + 522. Price 27 *sh.* 6 *d.*

The Methods of Plane Projective Geometry Based on the Use of General Homogeneous Co-ordinates. By E. A. Maxwell, 1960. Pp. xix + 230. Price 13 *sh.* 6 *d.*

A First Course in Mathematical Statistics. By C. E. Weatherburn, 1961. Pp. xv + 277. Price 18 *sh.* 6 *d.*

SCIENCE NOTES AND NEWS

Award of Research Degree

The Osmania University has awarded the Ph.D. Degree in Zoology to (Miss) Amir Sultana for her thesis entitled "Studies on the Nematode Parasites of the Birds of Andhra Pradesh (India)".

Annamalai University has awarded the Ph.D. Degree in Chemistry to Sri. V. Ramakrishnan for his thesis entitled "The Cryoscopic and Conductance Behaviour of some Organic Compounds in Ethanolamine".

Seventh Congress on Theoretical and Applied Mechanics

The Seventh Congress on Theoretical and Applied Mechanics will be held from December 23 to 26, 1961, at the Indian Institute of Technology, Bombay, Powai, Bombay-76.

Research papers may be contributed on any of the following topics: (1) Elasticity, Plasticity and Rheology; (2) Fluid Mechanics (Aerodynamics and Hydrodynamics); (3) Mechanics of Solids (Ballistics, Vibration, Friction and Lubrication); (4) Statistical Mechanics, Thermodynamics and Heat Transfer; (5) Mathematics of Physics and Statistics; (6) Experimental Techniques; (7) Computation Methods.

They should reach Dr. M. K. Jain, Officiating Secretary, with three copies of Abstracts by October 15, 1961.

Application Forms for Registrations and any other information may be obtained from the Officiating Secretary.

Control of Paddy Blast and Wheat Rusts

Messrs. R. S. Mathur, J. S. Jain and M. P. Misra, Section of Plant Pathology, Uttar Pradesh Government, Kanpur, write:

(I) In field trials on the control of paddy blast by organic mercury dusts, the comparative efficacy of the following three treatments was tested against blast caused by *Piricularia oryzæ* Cav. at the Usar Reclamation Farm, Chakeri (Kanpur), during the 1960-61 seasons.

(1) Ceresan and lime machine mixed in the ratio of 1 : 6 (0·3% Hg); (2) the same hand-mixed, and (3) Agrosan GN formulation (0·2% Hg).

After the first prophylactic dusting at the boot stage, the crop was dusted twice as a preventive measure against blast at intervals of 10 days. In the three treatments crop's yields showed increases of 41, 35 and 8% respectively in 0·08 acre plots, over the check plots which showed moderate to severe infection of blast.

(II) In a field trial on chemical control of wheat rusts, the efficacy of two spray fungicides, Dithane Z-78 (Zinc ethylene bis dithiocarbamate) and 0-3818 B (Nickel chloride hexa hydrate mixed with Dithane Z-78) was tested at Kanpur on an artificially rust-infected crop of Agra Local wheat in 1960-61. One prophylactic and two protective sprays completely controlled moderate and heavy infections of brown and black rusts.

A Simple Method of Hatching of Cysts of *Heterodera major* O. Schm.

Shri Gopal Swarup, Division of Mycology and Plant Pathology, Indian Agricultural Research Institute, New Delhi, writes: During the course of investigations of 'Molya' disease of wheat and barley, caused by *Heterodera major* O. Schm., some difficulty was experienced in getting daily a crop of freshly hatched larvæ for inoculation purposes. Though it is well known that cysts of this nematode do not need any root diffusate or chemical stimulant for hatching, yet merely keeping the cysts in tap-water did not yield a good hatch. Probably lack of oxygen is the chief reason for low hatching potential. The following simple method proved successful for obtaining a good crop of hatched larvæ for experimental work throughout the season. A circular piece of muslin cloth was stitched all round to a wire ring which could just conveniently go inside a petri dish, and rest on three glass rods placed in it. The petri dish was nearly filled with tap-water, and the wet muslin was always in contact with water. Batches of cysts were kept on top of the muslin along with a check wherein cysts were just put in water. The dishes were kept one over the other at room temperature (20-25° C.). The difference in the hatching was observed within 24 hours; the cysts kept on muslin cloth giving 50% more hatching than those placed in water. The hatched larvæ could be taken out daily and freshwater added.

Marine Fossiliferous Lower Eocenes from Dharmsala, Punjab

Dr. B. S. Tewari, Geology Department, Lucknow University, writes: Recently, a traverse was taken by the author and Shri P. S. Misra

of Dharmsala, of the Manjhi Khad about three miles east of Dharmsala with a view to investigate in detail the occurrence of the marine fossiliferous beds of Eocene age in the region as first reported upon by Dr. M. R. Sahni (*Rec. Geol. Surv. India: General Report for* 1946). Marine Eocene beds which have been referred to the Subathus occur at Subathu—Dharampur in Simla region on the eastern side, and Jangalgali and Pirpanjal Range in Jammu and Kashmir State on the Western side of the present locality.

About a mile north of the bridge over the Manjhi Khad, on the mule track leading to Kanihara from Dharmsala, there is an outcrop of dark grey, compact foraminiferal limestone in association with purple, red and grey shales on the right bank of the Manjhi Khad, containing *Nummulites atacicus, N. cf. mamilla, Assilina dandotica, A. spinosa, A. subspinosa* and badly preserved casts of Molluscs. The beds are thrusted against the massive Dharmakot Limestone and dip at a high angle towards north. The structure, however, is very complicated. The Grid Reference of the locality is D 600003 on the one inch map sheet No. 52 D/8.

The study confirms that the foraminiferal limestone referred to the Nummulitics by Dr. Sahni is of Lower Eocene age and is referable to the lower part of the Subathus.

High Intensity Magnet

The completion of a solenoid magnet at M.I.T. which generates a continuous magnetic field of 126 kilogauss signals the advent of an exploratory tool expected to have widespread scientific implications. It can, for example, help develop electron microscopes of unprecedented resolution, broader solid-state research experiments, and influence magnetohydrodynamic power generation.

Magnetic fields of a million gauss have been achieved with pulsed apparatus, but such fields have durations of only a microsecond or millisecond. Field produced in laboratory iron magnets have been limited by practical gap size and by the value at which iron saturates. Elimination of the iron requires approximately 1,000 times as much current to generate a field of equal intensity.

The design of the new magnet is due to H. Kolm of M.I.T. Lincoln Laboratory. The magnet consists of a tapered, 135-foot long ribbon of copper scored with 300 square slots and wound with insulation into a cylinder. Cooling water is forced between the aligned slots at 320 gallons per minute. In the centre of the coil is a tube, one inch in diameter by two inches long. An intense field is produced in the tube as 10,000 amperes of current pass through the coil. The principal limiting factor is the amount of well-regulated *d-c* power available. Cooling also imposes limitations. The Kolm magnet, built and tested at the available operating power of 1·88 megawatts, generates 126 kilogauss and is working at the new National Magnet Laboratory, M.I.T.

Among solid-state experiments that can take a giant step forward with high fields are the cyclotron resonance measurements of semiconductors. To get cyclotron resonance at submillimeter or infra-red wavelengths, a field of at least 200 kilogauss is needed. In the far-infra-red frequencies, work with pulsed fields is difficult and inaccurate, so continuous fields are needed.—(*Electronics, July* 28, 1961.)

Taxonomy of the Earthworm in India

Earthworms, apparently sent simultaneously to the British Museum (Natural History) and to the American Museum of Natural History for identification, have directed attention once more to the deplorable state of the taxonomy in a genus that may be dominant in a considerable portion of the Indian Peninsula. Each of the species left in that genus by a revision by G. E. Gates in 1939, based on an over-all somatic rather than genital anatomy, has remained indefinable hitherto. Material now studied by Gates, at the University of Maine, has enabled recognition not only of two further characters for generic definition but also has permitted, for the first time, fairly satisfactory characterization of a species based on data such as variation in sexual individuals secured in lots of some size from several localities (*Ann. Mag. Nat. Hist.*, 3, 35, November 1960). Previously unpublished information included in his account was obtained from 90 specimens collected for him at three localities in the Jubbulpore region during the Second World War.—(*Nature*, 1961, 191, 227.)

Carbon Dioxide Estimations in Stored Grain as Indication of Condition

The temperature of stored grain is widely used as a reliable guide to its condition during storage, and most modern grain elevators are provided with various types of grain temperature meters. A rise in temperature indicates metabolic activity by mould or insects.

Metabolic activity which causes the rise in temperature is also accompanied by production of carbon dioxide, and estimation of carbon

dioxide concentration in the intergranular atmosphere of stored grain will provide a method of detecting unwanted metabolic activity in the storage. In a note published in *Tropical Science* (1961, Vol. III, No. 1), Calderon and Shaaya have presented results of their experiments to assess the efficiency of the method.

The instrument used was a gas analyzer originally designed to measure fumigant concentrations by comparing the thermal conductivity of the experimental sample with that of a sample of air not containing carbon dioxide. The apparatus was calibrated by inserting amounts of carbon dioxide into a reservoir so as to yield graded concentrations of 0-15%. Samples of intergranular air were sucked into the gas analyzer through polyethylene tubes, probing to different depths in grain bins holding wheat or sorghum.

The results demonstrate the usefulness of the thermal conductivity analyzer for supervising grain in storage. The method promises to give sensitive indication of deterioration of bulk grain, whether due to insects or dampness.

Infra-Red Molecular Emission Spectroscopy by a Michelson Interferometer

The combination of a two-beam Michelson interferometer and Fourier transformation offers new prospects for the emission spectroscopy of sources of low brightness. Its effective application in the infra-red region 2-12 μ, where many molecular vibration bands are formed, has been described in a note by Gebbie *et al.* published in *Nature* (1961, 191, 264).

The low temperature radiation from a gas (*e.g.*, ammonia) contained in a heated cell with rocksalt windows, after chopping, passes through a specially designed Michelson interferometer to a detector. The interferogram of the radiation of the emitting gas is sampled at equal intervals of path-difference by a signal derived from the record of the mercury fringes. The values of intensity at these points are digitized and punched on paper tape suitable for input to a digital computer, where a programme for Fourier transformation gives the spectrum. The output of the computer is plotted automatically on a recorder. Comparison with an emission spectrum made with a conventional prism spectrometer shows that much superior resolution and signal-to-noise ratio is possible with the interferometer in comparable times of observation.

The Michelson-Fourier combination can be used for work on night-sky emission and also for observations on planetary atmospheres. Another possibility being investigated is the application to Raman spectroscopy with excitation lines of longer wavelength than those normally used.

Biochemical Composition of Coconut Water

Coconut water, the liquid endosperm of *Cocos nucifera* L., is used as a supplement in media for the growth of plant tissue cultures. Tissues from embryos, roots stems, endosperm and pollen of plants, including angiosperms and gymnosperms, may be grown on media containing this liquid. W. Tulecke *et al.* in a contribution from Boyce Thompson Institute (1961, Vol 21, p. 115) describe the normal constituents of coconut water as it is used in the culture of plant tissues.

Malic is the predominant organic acid. Alanine, γ-amino-butyric acid, and glutamic acid constitute about 75% of the free amino-acids of the fluid from mature fresh coconuts. Glutamine, arginine, asparagine, alanine and aspartic acid make up about 70% for young green coconuts.

Shikimic and quinic acids were detected in all samples, the greatest amounts being found in young green coconuts. This is perhaps the first report of these substances in coconut water. The probable role of these alicyclic acids in aromatic biosynthesis indicates their importance in the developing coconut; it is possible that they also play a role in the nutrition of plant tissue cultures.

The sugar content increases from 0·9 g./100 ml. in young fruits to 2·2 g./100 ml. in mature green coconuts. While the RNA-phosphorus content of fruits of different ages is fairly constant (about 30 μg./mg.), the DNA-phosphorus content increases from 0·06 μg./mg. in young green to 3·46 μg./mg. in mature coconuts.

It may be that other growth factors, lipid constituents, minor elements, etc., will be found. But the information already available should assist in the more rational use of coconut water as a supplement in nutrient media.

ERRATUM

In the June 1961 issue of *Current Science*, Column 1, line 10 from bottom on page 220 should read $X\Lambda C = -5\text{–}6°$ and not $X\Lambda C = 5\text{–}6°$.

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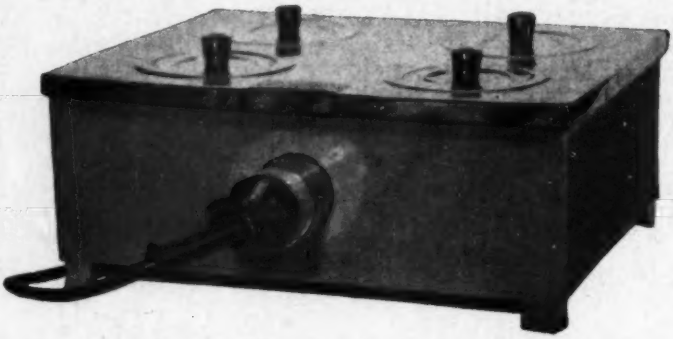

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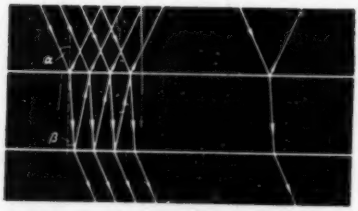

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Men like Naik are carrying forward a fine Jamshedpur tradition, recalling Jamsetji Tata's exhortation: "Let the Indian learn to do things for himself."

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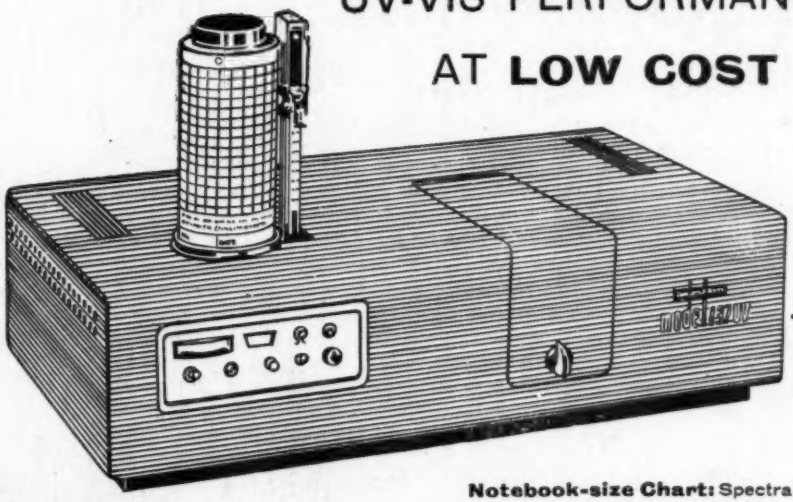

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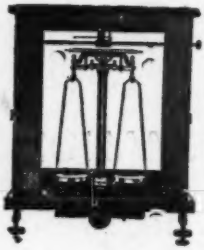

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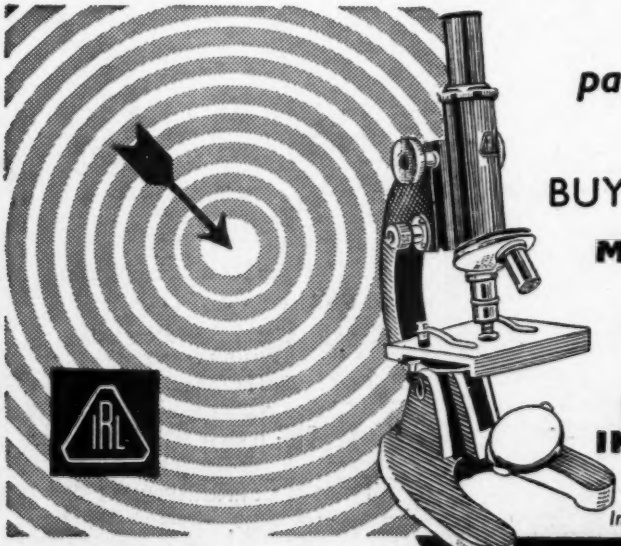

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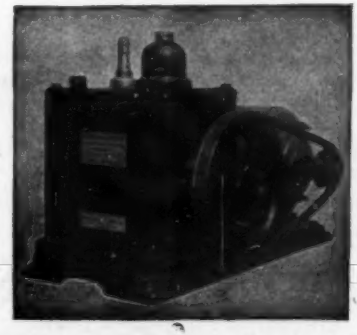

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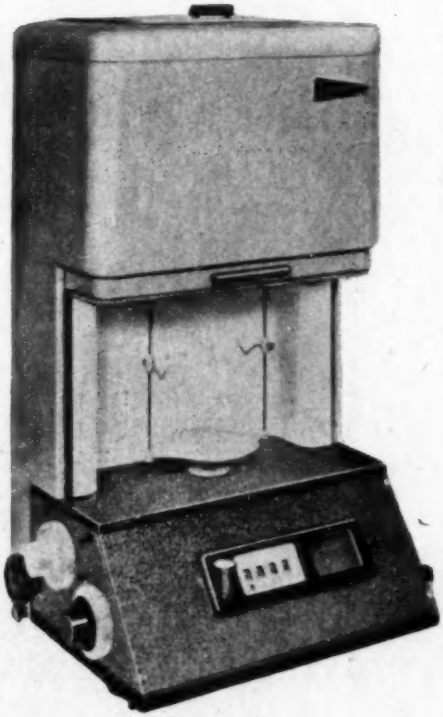

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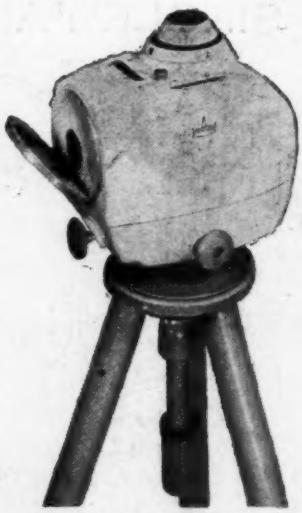

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